HASTINGS GENERATION PROJECT ENVIRONMENTAL NOISE IMPACT ASSESSMENT

ESSO

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EXECUTIVE SUMMARY

The Hastings Generation Project is to be located at an ExxonMobil owned site adjoining the existing Long Island Point (LIP) facility. The project consists of the use of ethane from LIP to generate power through the installation of three Solar Titan 130 power generation packages producing approximately 40MW of electricity. The power generated will be fed into the existing electricity transmission network via the Tyabb Terminal Station.

This report presents an assessment of potential noise emissions from The Project against Victoria's EPA Noise Limit and Assessment Protocol (Noise Protocol) and an assessment of low frequency noise emissions with respect to Victorian guidelines for low frequency noise (EPA Victoria Noise Guidelines: Assessing low frequency noise).

Noise levels due to the operation of the facility were predicted at nine nearby Noise Sensitive Areas (NSAs). Noise limits at the nine NSAs have been determined by comparing attended background noise measurements with zoning levels. For the purposes of this project, only night-time noise limits have been considered as night-time noise limits are the most stringent and the facility is anticipated to operate under steady-state conditions throughout daytime, evening and night-time periods.

Based on noise characteristics from the proposed equipment and Wood's experience of similar equipment items, it is possible that the noise emissions from The Project may exhibit tonal noise characteristics that may invoke adjustments to predicted noise levels at noise sensitive areas. Therefore, adjustments have been made to the predicted levels in accordance with Annex C of the Noise Protocol.

Noise level predictions assume adverse weather conditions for sound propagation towards the noise sensitive areas and that all items of the plant are continuously operational. Cumulative effective noise was assessed with reference to the Noise Protocol and Technical guide: Measuring and analysing industry noise and music noise (publication 1997) considering current ambient noise and the addition of noise generated from The Project at NSAs. These results are shown in Table 1-1.

Table 1-1 Summary of Night-time Assessed Noise Levels

NSA	Address	Noise Limit, dB(A)	Predicted Noise Levels, dB(A)	Effective Noise Level, dB(A)	Cumulative Effective Noise level, dB(A)
NSA 1	11 Cemetery Rd, Hastings VIC 3915	49	47.9	49	**51**
NSA 2	65 Skinner St, Hastings VIC 3915	41	33.8	40	41

NSA	Address	Noise Limit, dB(A)	Predicted Noise Levels, dB(A)	Effective Noise Level, dB(A)	Cumulative Effective Noise level, dB(A)
NSA 3	2 Hodgins Rd, Hastings VIC 3915	41	34.1	41	41
NSA 4	15A Lyall St, Hastings VIC 3915	43	31.5	41	42
NSA 5	34 Cemetery Road, Hastings VIC 3915	49	47.0	49	**51**
NSA 6	7 Beach Drive, Hastings VIC 3915	46	44.4	44	46
NSA 7	22 Beach Drive, Hastings VIC 3915	48	43.7	44	46
NSA 8	47 Beach Drive, Hastings VIC 3915	45	41.8	44	45
NSA9	14 Skinner St, Hastings VIC 3915	40	32.4	40	40

The cumulative effective noise levels exceed the most stringent (night-time) noise limits at two of the NSAs, those closest to the Project site. All remaining NSAs identified in the assessment are equal to or below the noise limit.

Low frequency and infrasound noise impacts have been modelled and assessed against the EPA's low frequency noise guidelines. The assessment predicts low frequency noise may result in exceedances of the threshold guidelines at NSA 1 and NSAs 5 through 8, all NSRs closest to the facility. The exceedances occur in the 31.5 Hz to 80 Hz 1/3 octave bands, although not all the NSAs exceed throughout the entire range. Existing measured levels are exceeding the thresholds in the 50 Hz to 80 Hz bands for NSA6 – NSA8, and in the 40 Hz to 80 Hz bands for NSA1 and NSA5.

The predicted low frequency exceedances are equal to or fall below the measured ambient noise levels and therefore unlikely to be audible. Received levels in the 31.5 Hz and 40 Hz are likely to be faintly audible at NSA 1 and NSA 5, while predicted levels at NSA 6 and NSA 7 may be faintly audible in the 31.5 Hz and 40 Hz bands, respectively. Predicted infrasound noise levels from The Project are significantly below the threshold levels at all noise sensitive areas and there are no exceedances for cumulative infrasound levels, therefore it is not anticipated that there will be any significant infrasound to emanate from The Project.

To reduce cumulative effective noise levels from the proposed facility at noise sensitive areas, it is recommended that a series of noise control measures are incorporated into the Solar equipment packages. These noise control measures are listed in Section 9.

As a condition of the Development Licence, an Operational Noise Management Plan will be created prior to commissioning. The Operational Noise Management Plan should address the areas outlined in Section 8.5.

The project has advised that major construction activities involving mobile equipment and loud hand tools will be limited to the normal working hours. It is recommended that The Project follow the guidance outlined in Section 4.3 of EPA's Publication 1834 to minimise noise and vibration risk as far as reasonably practicable.

Night construction works are not anticipated to involve the use of significant mobile or fixed plant noise sources, and additional power and lighting will be provided by existing power sources, eliminating the need for portable generators. Therefore, it is anticipated that The Project will meet the EPA's guidelines for noise levels for construction works undertaken outside the normal working hours.

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ACRONYMS AND DEFINITIONS

Parameter	Definition
Cumulative Noise Level	The cumulative noise assessment considers noise from The Project and from existing industry noise.
Environmental Commissioning Plan	A detailed Environmental Commissioning Plan is to be provided to the Authority at least 20 business days before the commencement of commissioning. The document entails monitoring programs to determine plant performance in accordance with the application.
Effective Noise Level	Effective noise levels are determined for noise from commercial, industrial and trade premises, as a 30-min equivalent sound pressure level LAeq,30min inclusive of any penalties for adjustments for duration, noise characteristics or measurement position, and rounded to the nearest decibel.
EPA	Environment Protection Authority (the Authority)
LIP	Esso's Long Island Point Facility
NMP	Noise Management Plan
Noise Limit	Regulatory noise limits determined using the Urban Area Method as defined by The Noise Protocol Part 1, Section A, Subsection 1.
NSA	Noise Sensitive Area
Project Noise Criteria[1]	Reporting condition DL_R4 point 2c) requires definition of Project Noise Criteria to ensure that cumulative noise levels do not exceed regulatory noise limits.
SLM	Sound Level Meter
The Project	Hastings Generation Project

[1] Since current noise emissions from LIP are equal to regulatory noise limits at some NSAs, meaningful Project Noise Criteria cannot be defined. Therefore, cumulative noise emissions have been assessed against the regulatory noise limits.

1 INTRODUCTION

The Hastings Generation Project is to be located at an ExxonMobil owned site adjoining the existing Long Island Point (LIP) facility. The project consists of the use of ethane from LIP to generate power through the installation of power generation packages producing approximately 40MW of electricity. The power generated will be fed into the existing electricity transmission network via the Tyabb Terminal Station. The three components of the project can be summarised as:

- Installation of new piping to transfer ethane from LIP to the adjoining, Esso owned project site
- Installation of three Solar Titan 130 generators, each with a capacity of 13.5MW producing approximately 40MW of electricity, on the project site that tie-in to the new ethane pipeline
- Installing a high voltage electricity line from the generators that links into the existing transmission network powerline on Bayview Road.

The Project started construction at the end of Q2 2023 and is anticipated to continue for approximately 6 months. It is anticipated that the facility will remain in operation for 11 years (2024 – 2034).

Noise from The Project has the potential to impact noise sensitive areas (NSAs) surrounding the proposed operations. Noise impacts at nine of the closest noise sensitive areas have been assessed based on noise modelling and background noise monitoring of The Project.

This report presents an assessment of noise emissions and noise controls for The Project inclusive of the following:

- Assessment of noise emissions from The Project with respect to the noise limits (Project Noise Limits) imposed under the Victorian *Noise Limit and Assessment Protocol (Noise Protocol)* at the closest noise sensitive areas.
- Assessment of low frequency noise emissions from The Project with respect to Victorian guidelines for low frequency noise (*EPA Victoria Noise Guidelines: Assessing low frequency noise – Publication 1996 June 2021*) at the closest noise sensitive areas.
- Assessment of cumulative noise emissions from The Project and existing noise emissions in accordance with the *Technical guide: Measuring and analysing industry noise and music noise* (EPA Publication 1997) and the *Noise Protocol*.
- Description of the noise controls currently implemented on noise sources associated with The Project and any additional noise attenuation control measures that could be installed as part of The Project including comments on their practicability.

2 DESCRIPTION OF SITE & OPERATIONS

2.1 Site Locality

The Hastings Generation Project will be constructed at a site adjourning the northern end of ExxonMobil's Long Island Point (LIP) facility. The proposed facility is to be located in an existing industrial area approximately 2km east of the town of Hastings. Figure 2-1 displays the proposed project area in relation the existing LIP facility.

Figure 2-1: Aerial Imagery of Site Locality (Red Square)

2.2 Noise Sensitive Areas

A noise sensitive area (NSA) has several definitions as per the Victorian Environmental Protection Regulations 2021[2]. Nine NSAs nearby the proposed facility were identified. The NSAs have all been identified as private residences/dwellings. The residential addresses of the NSAs are outlined in Table 2-1.

These residences were chosen to provide an inclusive and geographical spread of noise from The Project. They are representative of varying potential for environmental noise impacts due to their distance and direction from project noise sources. No residential locations were identified

[2] Victorian Environmental Protection Regulations 2021, Part 1.2 – Interpretation and introductory matters, Pages 21-23

to the northeast and those residents in the northwest were not assessed due to the significant distance from the facility. Similarly, NSAs located on French Island have not been assessed because French Island is located greater than 6km east of The Project and the potential for environmental noise impacts at this distance is minimal.

Environmental noise impacts are affected principally by geometrical spreading, meteorological factors and local ambient baseline noise conditions. Meteorological factors include wind direction, wind speed, temperature, pressure and humidity.

While the selection of NSAs to be assessed does not include every affected dwelling, it does include the most affected dwellings in various directions from the Project site. It is also considered sufficient to account for localised differences in ambient noise and in predicted noise emissions from the Project. Further to this, the selection of NSAs is also intended to represent the 'worst-case' potential for non-compliance with the regulations within the local vicinity.

Table 2-1 Residential address' of Assessed Noise Sensitive Areas

Noise Sensitive Areas	Address
NSA 1	11 Cemetery Rd, Hastings VIC 3915
NSA 2	65 Skinner St, Hastings VIC 3915
NSA 3	2 Hodgins Rd, Hastings VIC 3915
NSA 4	15A Lyall St, Hastings VIC 3915
NSA 5	34 Cemetery Road, Hastings VIC 3915
NSA 6	7 Beach Drive, Hastings VIC 3915
NSA 7	22 Beach Drive, Hastings VIC 3915
NSA 8	47 Beach Drive, Hastings VIC 3915
NSA 9	14 Skinner Street, Hastings VIC 3915

Figure 2-2 shows an overview of the noise sensitive areas (yellow) with reference to the proposed project area (red).

Figure 2-2: Location of Project Area and Noise Sensitive Areas

2.3 Operational Activities

It is anticipated that the proposed facility will comprise of the following (noise generating) equipment:

- 3 x Solar Titan 130 Gas Turbine Generator packages, consisting of the following:
    - Enclosed compressor package including baseframe
    - Turbine air system
    - Enclosure ventilation
    - Turbine exhaust system
    - Lube oil cooler
- 3 x Fuel gas skid
- 2 x Instrument air package
- 2 x Transformers

3 CONSTRUCTION NOISE

Victoria does not have regulatory limits for noise from construction works. Instead, EPA Victoria provides guidance to help operators reduce noise impacts from construction works through EPA Victoria's *Civil construction, building and demolition guide, Publication 1834, 2020 (replaces EPA Publication 480 and Publication 1254).*

The EPA's Publication 1834 states:

Under the general environmental duty, anyone who is engaging in an activity that poses risk of harm to human health and the environment, from pollution or waste, must manage that risk. You need to do this by ***eliminating or reducing your specific risks as far as reasonably practicable****. You can do this by putting appropriate controls in place.*

Key aspects to consider when you are planning include:

- *Identifying people and sensitive environments (sensitive receivers) that could be affected by your activities*
- *Carrying out appropriate engagement as early as possible*
- *Avoiding the generation of noise and vibration*
- *Facilitating construction during normal working hours, where possible (See* Table 3-1*)*
- *Reducing noise and vibration by using the most appropriate equipment and work practices for your activities*
- *Choosing alternative equipment or methods that generate less noise or vibration*
- *Maintaining equipment and vehicles according to manufacturer's instructions*
- *Attenuating noise by obstructing the path between noise source and receiver*
- *Mitigating offsite noise with measures such as respite offers and acoustic treatment*
- *Considering alternatives if noise and vibration cannot be reduced through avoidance, reduction or attenuation.*

The EPA's Publication 1834 provides recommended working hours for construction sites of major infrastructure works, including the development of power facilities, and guidelines for noise levels for works undertaken outside normal working hours. The recommendations given in Section 4.4 of Publication 1834 are summarised in Table 3-1 below.

Table 3-1 Construction Noise Working Hours

Period	Working Hours	Description
Normal Working Hours	• 0700 – 1800, Monday – Friday; and • 0700 – 1300 Saturday	No noise level guidelines apply
Outside Normal Working Hours	• 1800 – 2200, Monday – Friday; • 1300 – 2200, Saturday; and • 0700 – 2200, Public Holidays	Construction noise levels should not exceed the background LA90 level by: • 10dBA or more for up to 18 months after project commencement; • 5dBA or more, after 18 months after project commencement
Outside Normal Working Hours (Night)	• 2200 – 0700, Monday – Sunday, (inc. Public Holidays	Noise is to be inaudible within a habitable room of any residential premises

The project has advised Wood that major construction activities involving mobile equipment and loud hand tools will be limited to normal working hours. Night construction works may be undertaken, however they will be limited to activities such as cable laying activities which are not anticipated to involve the use of significant mobile or fixed plant noise sources. Additionally, it is anticipated that additional lighting and power may be required but will be provided by existing power sources, eliminating the need for portable generators.

4 BACKGROUND NOISE MONITORING

Noise monitoring was undertaken to establish current background noise levels and to assist with establishment of facility noise limits. Background noise measurements were undertaken outdoors at background equivalent locations.

4.1 Methodology

Attended background noise monitoring was undertaken on the night of 5th June 2023 at locations representative of NSAs 1 to 9 listed in Table 2-1. The attended monitoring data was measured and analysed in accordance with the short background method[3] detailed in The Noise Protocol. The measurements represent the background level for a full night period.

4.1.1 Noise Level Descriptors

The noise parameters outlined in Table 4-1 were measured throughout the logging period. The noise parameters were logged over at least two intervals of 10 minutes over the (night-time) period.

Table 4-1 Noise Level Descriptors

Parameter	Definition
$L_{AF\ 1}$	A sound level, determined as an $L_{A\ Fast}$ value, exceeded for 1% of the time period over which the level is determined.
$L_{AF\ 10}$	A sound level, determined as an $L_{A\ Fast}$ value, exceeded for 10% of the time period over which the level is determined.
$L_{AF\ 90}$	A sound level, determined as an $L_{A\ Fast}$ value, exceeded for 90% of the time period over which the level is determined (commonly referred to as the background noise level if a measurement of ambient noise is made before the proposal is in operation).
$L_{A\ eq}$	The equivalent continuous sound level that has the same energy as the fluctuating sound under consideration over the time period which the level is determined.

4.2 Measurement Equipment

A Brüel & Kjaer Sound Level Meter (SLM) was used to undertake the attended noise monitoring. The meter is designed to meet the requirements for Type 1 instruments as specified in AS IEC

[3] *Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues*, EPA Publication 1826.4 Part 1A, Section 4. Assess background level to set noise limits for the urban area method or the rural area method

61672.1-2004 and for 1/3 octave band filters as specified in AS/NZS 4476:1997 *Acoustics—Octave-band and fractional-octave-band filters*.

The SLM was field calibrated prior to starting measurements and on completion of measurements using a Brüel and Kjaer Type 4231 reference sound source. A list of equipment used is given in Table 4-2 below.

Table 4-2 Noise Monitoring Equipment

Equipment Type	Serial Number
Sound Level Meter, Brüel & Kjaer Type 2270	2664185
Reference Sound Source, Brüel & Kjaer Type 4231	2253111

4.2.1 Measurement Uncertainty

AS IEC 61672.1-2004 Clause 5.6.5 and Clause 5.6.7 detail acceptable level of linearity for a Class 1 SLM:

- *Clause 5.6.5*: Measured values of level linearity deviations shall not exceed ± 0,8 dB for class 1 and ± 1,1 dB for class 2 sound level meters.*
- *Clause 5.6.7*: The specifications in 5.6.5 and 5.6.6 apply over the total level range for any frequency within the frequency range of the sound level meter and for any frequency weighting or frequency response provided.*

**NOTE: In principle, the requirements for level linearity apply at least for any frequency from 16 Hz to 16 kHz for class 1 sound level meters and from 20 Hz to 8 kHz for class 2 sound level meters.*

The standard does not provide an acceptable level linearity deviation for 1/3 octave band data measured at for linearity below 16 Hz. However, a review of the Brüel and Kjaer SLM User Manual[4] states that the free field frequency range for the B&K 2270 SLM with standard 4189 microphone has a ± 1 dB response for frequencies ranging from 6.8 Hz to 22.4 kHz.

In summary, measurements undertaken using the Brüel & Kjaer SLM in the infrasound range are capable of ± 1 dB as per the Brüel and Kjaer SLM User Manual.

[4] USER MANUAL - Hand-held Analyzer Types 2250 and 2270, *Brüel and Kjaer,* (2016)

4.3 Monitoring Locations

Attended monitoring background measurements were undertaken at background equivalent locations (BEL) in accordance with Clause 40 & 42[5] of the Noise Protocol. The BELs are representative of NSAs 1 to 9 identified in Table 2-1 . The measurement locations were selected consistent with the definition of background level in the Noise Protocol; the background level must represent 'the background sounds in a noise sensitive area, in the absence of noise from any commercial, industrial or trade premises which appears to be intrusive at the point where the background level is measured. Locations within the specifications of the definition were used in the assessment. The measurement locations (in degrees, minutes, seconds) is provided in Table 4-3 below and shown in Figure 4-1.

Table 4-3 Attended Monitoring Locations

Noise Sensitive Area	Latitude	Longitude
NSA 1 BEL	38°20'07.9"S	145°11'59.2"E
NSA 2 BEL	38°18'12.4"S	145°10'46.8"E

[5] *Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues*, EPA Publication 1826.4 Part 1A, Section 4. Assess background level to set noise limits for the urban area method or the rural area method, Clause 40 & 42.

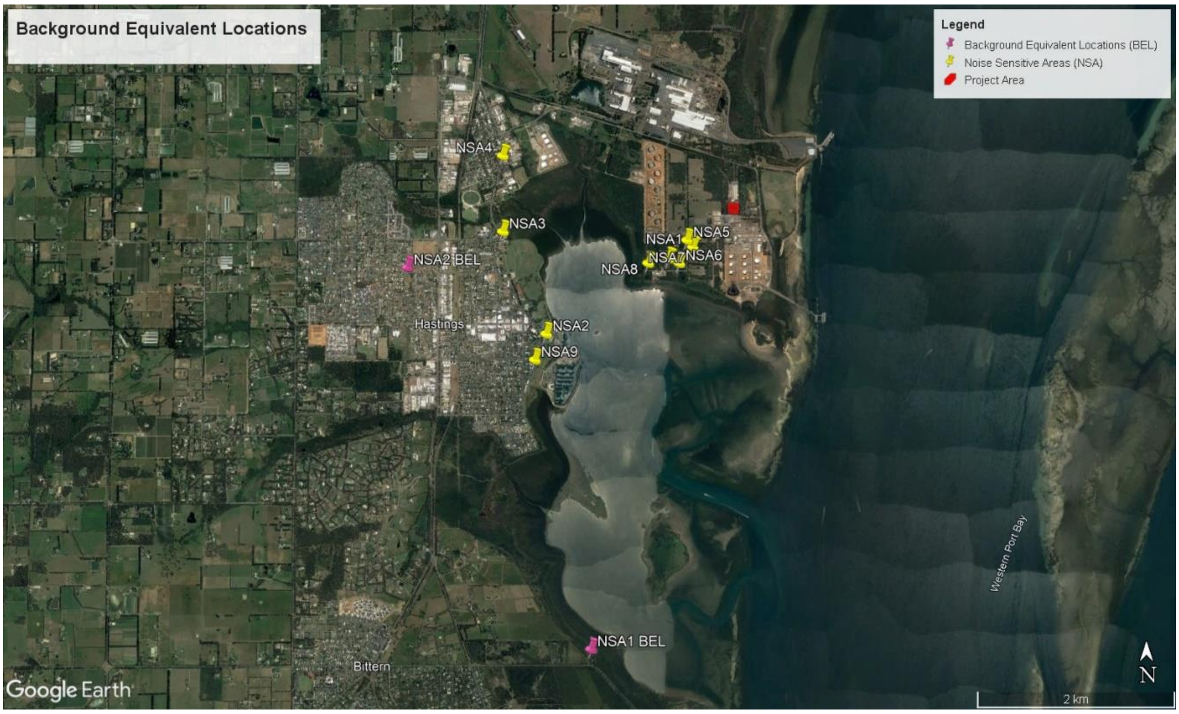


Figure 4-1 Background Equivalent Locations and Noise Sensitive Areas

Background noise monitoring at NSA 1 BEL, is representative of noise monitoring at NSAs 1, 5 to 8 and other dwellings in close proximity to The Project (e.g. dwellings on Picnic Avenue, Beach Avenue, and other dwellings on Cemetery Road). These residences are affected by the same environmental conditions (baseline, influenced by roads, rail and nearby industry) and located at a similar distance and direction from The Project. Background noise monitoring at NSA 2 BEL, is representative of noise monitoring at NSAs 2 to 4 and other dwellings located in Hastings town.

4.4 Results

The measured background noise levels are presented in Table 4-4.

Detailed results for the attended noise monitoring undertaken are presented in APPENDIX B.

Table 4-4 Measured Background Noise Levels

NSA BEL	Measured Background Noise Level, $L_{AF\ 90}$	Observations
1	36	Calm clear skies. Occasional traffic and insect noise.
2	37	Calm clear skies. Occasional traffic, bird and bat noise.

5 NOISE LIMITS

5.1 Derivation of Noise Limits

Noise emissions from commercial, industrial, trade premises and entertainment venues in Victoria are regulated under the *Noise Limit and Assessment Protocol (Noise Protocol)*[6]. The Noise Protocol specifies the procedure for determining noise limits at noise sensitive areas near a proposed facility or activity.

The proposed Esso Power Generation facility is located in Hastings, Mornington Peninsular and within the Melbourne major urban area, as shown in Figure 5-1. Therefore, noise limits have been determined using the Urban Area Method as defined by The Noise Protocol Part 1, Section A, Subsection 1.

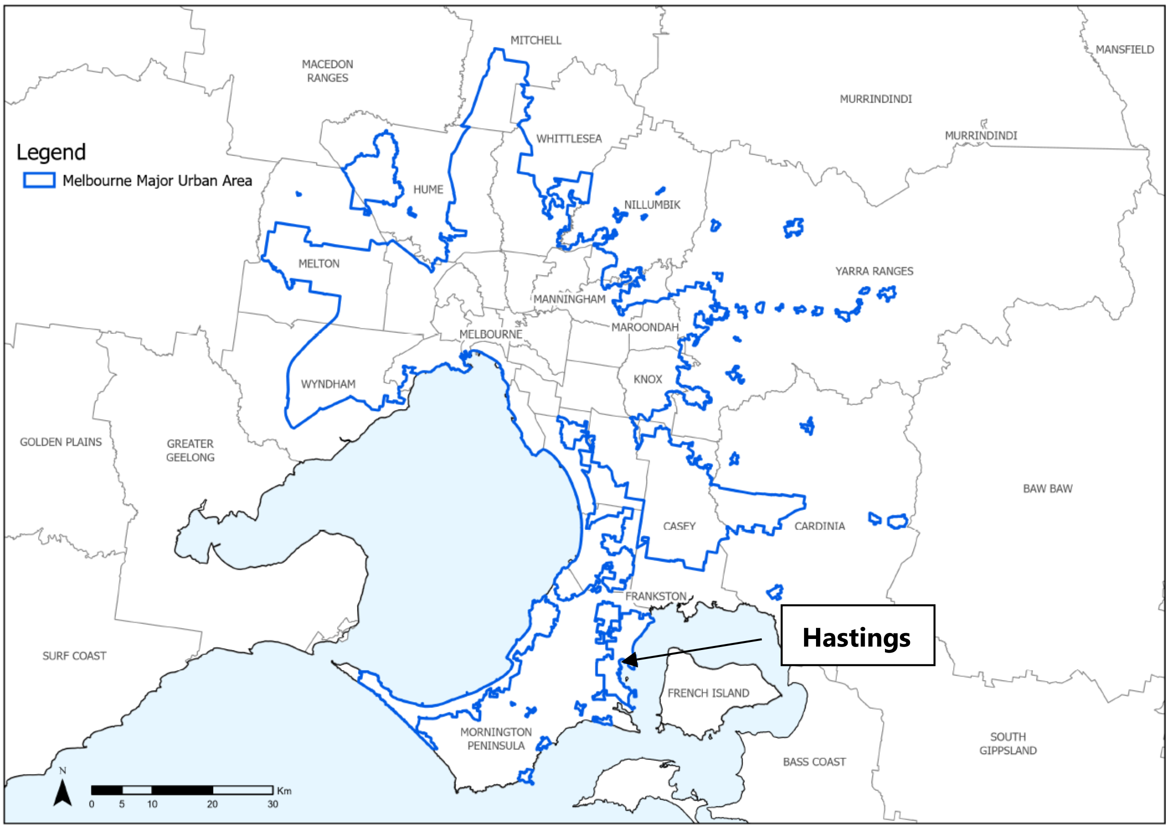


Figure 5-1: Location of Hastings within the Melbourne Major Urban Area

[6] *Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues*, EPA Publication 1826.4 Part 1A

The following operational time periods (day, evening and night) as outlined in Table 5-1 are defined in the Noise Protocol.

Table 5-1 Operating time periods

Period	Details
Day	0700—1800, Monday - Saturday (excluding public holidays)
Evening	1800—2200, Monday - Saturday
	0700—2200, Sunday and public holidays
Night	2200—0700

For the purposes of this project only night-time noise limits have been considered in the assessment as these limits are the most stringent. The facility is anticipated to operate under steady-state conditions throughout daytime, evening and night-time periods.

The noise limits set by the Noise Protocol are influenced by the zoning of land uses surrounding a noise sensitive area and the existing background noise level.

5.1.1 Zoning Levels

In accordance with the Noise Protocol, the zoning level[7] is determined by applying two concentric circles of diameters of 140 m and 400 m, with the centre of the circles placed at the centre of each identified sensitive area. Within each of these circles the area of each zoning type was determined and from this the zoning levels were calculated.

The night-time zoning levels for each noise sensitive area are summarised in Table 5-2.

Table 5-2 Influencing Factor and Zoning Levels

Noise Sensitive Area	Land Zoning within circles centred on NSA[8]		Influencing Factor	Zoning Levels, dB(A)
	140 m diameter	400 m diameter		Night time period
NSA 1	SUZ1	SUZ1 PCRZ PUZ5	0.93	55
NSA 2	PPRZ	PPRZ	0.09	41

[7] *Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues*, EPA Publication 1826.4 Part 1A, Section 1.1 Zoning Level

[8] *Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues*, EPA Publication 1826.4 Annex A, Table A.1 & Table A.2

Noise Sensitive Area	Land Zoning within circles centred on NSA[8]		Influencing Factor	Zoning Levels, dB(A)
	140 m diameter	400 m diameter		Night time period
	PUZ3 RDZ2 GRZ1	PUZ3 RDZ2 GRZ1 PUZ6		
NSA 3	GRZ1 C1Z RDZ2 PUZ2	GRZ1 C1Z RDZ2 PUZ2 PPRZ	0.14	41
NSA 4	GRZ1 RDZ2 IN3Z	GRZ1 RDZ2 IN3Z	0.26	43
NSA 5	SUZ1	SUZ1 PUZ5	0.99	56
NSA 6	PCRZ SUZ1	PUZ5 PCRZ SUZ1	0.62	50
NSA 7	PCRZ SUZ1	PUZ5 PCRZ SUZ1	0.87	54
NSA 8	PCRZ SUZ1	PUZ5 PCRZ SUZ1	0.54	48
NSA 9	GRZ1 PPRZ	GRZ1 PPRZ	0.00	39

5.1.2 Noise Limits at Selected Receptors

The background noise levels were compared to the night-time zoning levels and a determination on whether the background noise level, relative to the zoning level, is neutral, low or high was made in accordance with Clause 4[9] of the Noise Protocol. Table 5-3 details the background noise

[9] *Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues*, EPA Publication 1826.4 Part 1A, Section 1. Noise limits – urban area method, Clause 4

level assessment and outlines the noise limits which were determined in accordance with Clauses 5 or 6[10] of the Noise Protocol

Table 5-3 Background Noise Level Assessment & Noise Limits

Noise Sensitive Area	Background Noise Level, dB(A)	Night time zoning Level, dB(A)	Background Noise Level Assessment	Comment	Night time noise limit, dB(A)
NSA 1	36	55	Low	Noise limit is ½ (zoning level + background level) + 3 dB	**49**
NSA 2	37	41	Neutral	Noise limit based is zoning Level	**41**
NSA 3	37	41	Neutral	Noise limit based is zoning Level	**41**
NSA 4	37	43	Neutral	Noise limit based is zoning Level	**43**
NSA 5	36	56	Low	Noise limit is ½ (zoning level + background level) + 3 dB	**49**
NSA 6	36	50	Low	Noise limit is ½ (zoning level + background level) + 3 dB	**46**
NSA 7[11]	36	54	Low	Noise limit is ½ (zoning level + background level) + 3 dB	**48**

[10] *Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues*, EPA Publication 1826.4 Part 1A, Section 1. Noise limits – urban area method, Clause 5 / Clause 6

[11] *Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues*, EPA Publication 1826.4 Part 1A, Section 1. Noise limits – urban area method, Clause 5 / Clause 6

Noise Sensitive Area	Background Noise Level, dB(A)	Night time zoning Level, dB(A)	Background Noise Level Assessment	Comment	Night time noise limit, dB(A)
NSA 8[11]	36	48	Low	Noise limit is ½ (zoning level + background level) + 3 dB	**45**
NSA 9	37	39	High	Noise limit is the background level + 3 dB, but not greater than 55 dB(A)	**40**

5.1.3 Cumulative Noise Levels

In accordance with the Noise Protocol, the Technical Guide[12], and Regulation 119 from The Regulations, this assessment has considered potential for cumulative noise impacts. Review of the EPA's approved projects and Engage Victoria website suggests that there are no other applicable proposed developments in the Hastings area which may contribute cumulatively to noise levels at noise sensitive areas. Potential future noise sources at the Port of Hastings (Woolley Beach & Stony Point) are located approximately 4.5km from NSR9 (closest receiver) and therefore unlikely to significantly impact noise received at the Hastings NSAs.

However, all existing industrial facilities including Esso's LIP which contribute to noise levels at the NSAs have been assessed in combination with predicted noise from The Project to assess cumulative impacts. The cumulative noise levels for all NSAs will be assessed against the noise limits defined in Table 5-3.

5.2 Low Frequency Noise Guidelines

5.2.1 Low Frequency Noise Limits

Guidelines on assessing low frequency noise are provided in the *Noise Guidelines: Assessing Low Frequency Noise*[13]. The publication contains indoor and outdoor threshold levels that are derived from UK DEFRA[14] criteria. Advice provided in the publication is that the threshold values described are to be considered guidelines rather than compliance limits.

[12] Technical guide: Measuring and analysing industry noise and music noise (EPA Publication 1997

[13] *EPA Victoria Noise Guidelines: Assessing low frequency noise – Publication 1996 June 2021*

[14] *University of Salford Manchester, Procedure for the assessment of low frequency noise disturbance, Revision 1, December 2011*

The disturbance from low frequency noise depends on the noise level, characteristics that can increase annoyance with the noise such as tonality and frequency modulation, and baseline noise levels in the absence of the noise of concern.

The low frequency threshold levels (excluding infrasound level) used in this assessment are presented in Table 5-4.

Table 5-4 Low Frequency Threshold Levels (Excluding Infrasound Levels)

1/3 octave Band Frequency Levels (Hz)										
		25	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**
Threshold Levels	LZeq (dB)	69	61	54	50	50	48	48	46	44
	LAeq (dBA)	24	22	19	20	24	26	29	30	31

5.2.2 Infrasound

Infrasound is typically considered to be noise within the frequency range 0 - 20 Hz and is generally considered to be inaudible. The *Noise Guidelines: Assessing Low Frequency Noise*[15] do not specifically address emissions or impact of infrasound. For the purposes of this assessment, the low frequency assessment guidelines stated in Section 5.2.1, and derived from the UK DEFRA criteria will be used. This is inclusive of those bands at the lower end of the spectrum to provide a measure of infrasound.

Table 5-5 Infrasound Threshold Levels

One-third Octave Frequency Levels (Hz dB)							
		6.3	**8**	**10**	**12.5**	**16**	**20**
Threshold Levels	LZeq (dB)	-[16]	-	92	89	86	77
	(dBA)	-	-	22	26	29	27

[15] *EPA Victoria Noise Guidelines: Assessing low frequency noise – Publication 1996 June 2021*

[16] The threshold levels from the guidelines are provided from 10 Hz to 160 Hz.

5.3 Other Applicable Criteria - General Environmental Duty

The General Environmental Duty (GED) applies to all Victorian businesses. The Project must take all reasonable steps to minimize harm to human health and the environment from pollution and waste including noise.

The GED applies at all times, during construction and operation of a project, for any activities posing a risk of harm to human health and the environment.

The following sections of the Environment Protection (EP) Act apply to the GED:

- Section 25(1) of the EP Act states that a person who is engaging in an activity that may give rise to risks of harm to human health or the environment from pollution (including noise, which includes sound and vibration) must minimise those risks so far as reasonable and practicable.
- Section 6 of the EP Act states that minimising risks of harm to human health and the environment requires the duty holder to eliminate risks of harm to human health and the environment so far as reasonably practicable and, if it is not reasonably practicable to eliminate those risks, then reduce those risks as far as reasonably practicable.
- Section 6(2) of the EP Act states factors to give regard to when determining what is reasonably practicable in relation to the minimising of risks to harm to human health and the environment.

6 NOISE MODELLING METHODOLOGY

6.1 Noise Model

A noise propagation model has been developed using the SoundPlan 8.2 program developed by SoundPLAN LLC. This program calculates sound pressure levels at nominated receiver locations or produces noise contours over a defined area of interest around the noise sources. SoundPlan can be used to model different types of noise, such as industrial noise, traffic noise and aircraft noise, and it is professionally recognised in Australia and internationally. The inputs required in SoundPlan are noise source data, ground topographical data, meteorological data and receiver locations.

SoundPlan provides a range of prediction algorithms that can be selected by the user. The CONCAWE prediction algorithms were selected for this assessment[17,18]. The acoustic model has been used to generate a noise contour for the area surrounding the Project and predict noise levels at the nearby noise sensitive (residential) locations.

The acoustic model does not include noise emissions from any source other than the proposed operations from The Project. Therefore, noise emissions from other neighbouring industrial sources, road traffic, aircraft noise, animals, domestic sources, etc are excluded from the modelling.

6.2 Noise Modelling Scenarios

6.2.1 Operational Scenario

For the purposes of this project only one operating scenario (night-time) of the proposed Hastings Generation Project has been considered as night-time noise limits are the most stringent and the facility is anticipated to operate under steady-state conditions throughout daytime, evening and night-time periods.

Table 6-1 outlines the equipment and respective quantity used for this modelling scenario.

[17] CONCAWE (Conservation of Clean Air and Water in Europe) was established in 1963 by a group of oil companies to carry out research on environmental issues relevant to the oil industry.

[18] The propagation of noise from petroleum and petrochemical complexes to neighbouring communities, CONCAWE Report 4/81, 1981

Table 6-1 Quantity of Operational Equipment for Modelled Scenario

Equipment	No. of units
Solar Titan 130 Power Generator Package, including: • Enclosure; • Enclosure ventilation • Turbine air inlet system, • Combustion outlet system.	3
Lube Oil Cooler	3
Fuel Gas Skid	3
Instrument Air Compressor (2 x units at 100% standby / duty)	1
Transformers	2

6.3 Meteorological Conditions

The CONCAWE prediction algorithm includes consideration of the effect on noise propagation of defined meteorological conditions. The following variables are included that will affect the predicted noise level: temperature; Pasquill stability (temperature inversion); relative humidity; wind speed; and wind direction.

Noise emissions have been predicted under adverse weather conditions favourable for noise propagation from the facility to the nearest residences, in accordance with this requirement.

These noise model inputs are summarised in Table 6-2 below.

Table 6-2 Meteorological Model Inputs for Adverse Conditions

Input	Adverse Conditions
Wind Speed (m/s)	3
Wind Direction	Source to Receiver
Pasquill-Gifford stability class (Atmospheric Stability)	F
Humidity (%)	50
Temperature (degrees Celsius)	15
Air Pressure (mbar)	1013.3

6.4 Ground Topography, Buildings and Barriers

Topographical information for the acoustic model has been imported from Google Earth. A moderately absorptive (ground factor 0.6) ground is assumed for forest, farmland surrounding the facility and a relatively reflective (ground factor 0.3) is assumed for the facility and other nearby industrial premises, and water surrounding the facility is assumed to be fully reflective (ground factor 0.0)

The model also includes the acoustic barrier effects and reflections associated with buildings within the locality.

6.5 Uncertainty in Noise Modelling

Uncertainty of the CONCAWE algorithm has been determined in a CONCAWE report[19]. The 95% confidence limits for Octave Band frequencies ranging from 63 Hz to 4 kHz with various meteorological categories within the algorithm are described in Table 6-3 below. The confidence limits are a measure of the accuracy of the model to predict the sound level at a certain place for an individual measurement under each of the defined meteorological categories.

Table 6-3 95% Confidence Limits for the CONCAWE Model

95% Confidence Limits for CONCAWE Model								
Meteorological Category	dB(A)	Octave Band Centre Frequency						
		63	125	250	500	1k	2k	4k
2	6.8	5.4	5.4	9.1	9.4	7.8	9.8	12.4
3	6.9	5.0	6.2	9.4	10.1	8.5	8.5	9.4
4	5.7	4.8	6.5	8.7	9.8	6.6	5.6	6.7
5	4.7	3.9	5.4	8.4	8.1	5.2	5.6	6.7
6	4.6	5.2	6.1	6.7	9.3	4.9	5.5	8.2

Worst-case weather conditions for noise propagation (meteorological category 6) have been assumed in the noise modelling which includes the presence of a temperature inversion, wind speed of 3 m/s and NSAs downwind of the facility.

A further statistical assessment of the CONCAWE algorithm was determined in the CONCAWE report. The mean differences between the predicted and observed noise levels in each meteorological category were calculated, providing a quantitative measure of model algorithm

[19] The propagation of noise from petroleum and petrochemical complexes to neighbouring communities, CONCAWE Report 4/81, 1981

performance over a longer-term timeframe. The mean difference for overall level and individual octave bands are listed Table 6-4 below.

Table 6-4 Mean Difference for the CONCAWE Model

Mean Difference (Observed minus predicted) for CONCAWE Model								
Meteorological Category	dB(A)	Octave Band Centre Frequency, Hz						
		63	125	250	500	1k	2k	4k
2	0.5	0.1	0.1	2.0	2.2	2.2	-0.2	0.4
3	0.6	-0.0	0.5	1.6	0.4	0.8	0.8	0.4
4	0.5	0.3	0.8	-1.2	-0.2	0.1	1.4	0.2
5	0.0	-0.1	-0.0	-2.3	0.4	-0.6	0.9	-0.9
6	0.5	-0.8	-0.3	-1.7	1.2	-0.2	0.1	-0.9

6.6 Noise Source Emission Data

Overall noise emission data for the Titan 130 Package and associated equipment were provided by the nominated vendor (Solar). Sound power levels for the modelled equipment items are shown in Table 5-3. The overall sound power levels associated with this Solar equipment assumes incorporation of the following noise controls:

- Acoustic blanket on engine air inlet silencer and flex duct
- Acoustic blanket on engine exhaust expansion joint
- Cladding on web of skid beam
- Additional enclosure door seals
- Acoustic blanket on ventilation inlet elbow and fans
- Low noise fans on the lube oil cooler

The performance of these noise control treatments, and effective reduction in emissions of the standard Solar Titan 130 package has been estimated by Solar based on design/materials data, and not based upon direct measurement of performance.

For additional equipment items not associated with the Titan 130 package, where sound power level data was not available, and for spectral data of all modelled noise sources, verifiable 1/3 octave band data measured by Wood on similar equipment at existing oil and gas, compression or power generation facilities has been utilised.

1/3 Octave-band noise source sound power levels for the equipment in the noise model are listed in Table 6-5. For the purposes of this assessment, it has been assumed that all items of plant are continuously operating.

Table 6-5 Noise Source (Sound Power) Levels for Operational Equipment for Modelled Scenario

Equipment	No. of units	Sound Power Level, Lw, dB(A)
Solar Titan 130 • Enclosure (+ventilation) • Turbine air inlet system • Combustion exhaust stack	3	 107 97 103
Lube Oil Cooler	3	98
Fuel Gas Skid	3	96
Instrument Air Package	1	95
Transformer	2	90

6.7 Assessment of Cumulative Noise Levels

The cumulative noise assessment considers noise from The Project and from existing industry noise. At NSAs 1, 5 through to 8, the cumulative noise impacts from Esso's combined facilities (LIP + The Project) has been assessed. Cumulative noise levels were also determined for NSAs 2 through 4 and 9 based off the respective measured cumulative contribution at these locations. Contribution at these locations include United Energy and BlueScope.

The cumulative noise level is determined by logarithmic addition of the measured noise level from industry and the predicted level from The Project. The measured noise levels have been adjusted to remove extraneous noise such as birds, traffic, rain and wind.

6.8 Low Frequency & Infrasound Noise Modelling

Low frequency and infrasound noise emissions is most likely to originate from the Titan 130 exhaust stack. Solar has provided 1/3 Octave noise emissions for the stack outlet in the infrasound range (6.3 Hz to 20 Hz). These levels are listed in APPENDIX C.

7 NOISE ASSESSMENT

7.1 Predicted Noise Levels

The noise levels that would be generated at the noise sensitive area by operation of the Hastings Generation Project were modelled under the adverse weather conditions set out in Section 6.3. The predicted noise levels are presented in Table 7-1 below.

Table 7-1 Predicted Noise Levels

Noise Sensitive Area	Address	Predicted noise level, dB(A)
NSA 1	11 Cemetery Rd, Hastings VIC 3915	45.9
NSA 2	65 Skinner St, Hastings VIC 3915	31.8
NSA 3	2 Hodgins Rd, Hastings VIC 3915	32.1
NSA 4	15A Lyall St, Hastings VIC 3915	29.5
NSA 5	34 Cemetery Road, Hastings VIC 3915	45.0
NSA 6	7 Beach Drive, Hastings VIC 3915	42.4
NSA 7	22 Beach Drive, Hastings VIC 3915	41.7
NSA 8	47 Beach Drive, Hastings VIC 3915	39.8
NSA 9	15 Skinner St, Hastings VIC 3916	30.4

A noise contour displaying the predicted noise impact from The Project is presented in APPENDIX D.

7.1.1 Tonality Assessment

Predicted noise levels have been assessed for tonality in accordance with Annex C of the Noise Protocol. This protocol applies to measured noise levels to determine effective noise levels outlined in Section 7.2. This assessment is for noise model predicted levels therefore the use of the protocol is considered a conservative assessment of tonality.

The assessment indicates that a +2 dB adjustment is required for the predicted noise levels at all noise sensitive receivers. Table 7-2 outlines the predicted noise levels accounting for the tonal adjustment.

Table 7-2 Tonality Adjusted Predicted Noise Levels

Noise Sensitive Area	Address	Adjusted Predicted Noise Level, dB(A)
NSA 1	11 Cemetery Rd, Hastings VIC 3915	47.9
NSA 2	65 Skinner St, Hastings VIC 3915	33.8
NSA 3	2 Hodgins Rd, Hastings VIC 3915	34.1
NSA 4	15A Lyall St, Hastings VIC 3915	31.5
NSA 5	34 Cemetery Road, Hastings VIC 3915	47.0
NSA 6	7 Beach Drive, Hastings VIC 3915	44.4
NSA 7	22 Beach Drive, Hastings VIC 3915	43.7
NSA 8	47 Beach Drive, Hastings VIC 3915	41.8
NSA 9	15 Skinner St, Hastings VIC 3916	32.4

7.2 Effective Noise Levels

Effective noise levels[20] are determined for noise from commercial, industrial and trade premises, as a 30-min equivalent sound pressure level LAeq,30min inclusive of any penalties for adjustments for duration, noise characteristics or measurement position, and rounded to the nearest decibel.

Wood undertook environmental noise monitoring using SVANTEK 977 Series Class 1 equipment at multiple locations in the vicinity of LIP and Hastings town over a measurement duration of up to one week, including multiple weekdays and a weekend in September 2023. The locations of

[20] *Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues*, EPA Publication 1826.4 Part B, Section 2. Effective Noise Levels

these short-term noise loggers (#1 and #2) along with NSA4 and NSA2 short term noise loggers represent Noise Sensitive Areas (NSAs) which may be impacted by operations at LIP, HGP and other existing commercial, industrial premises in the vicinity. Figure 7-1 demonstrates the logger locations.

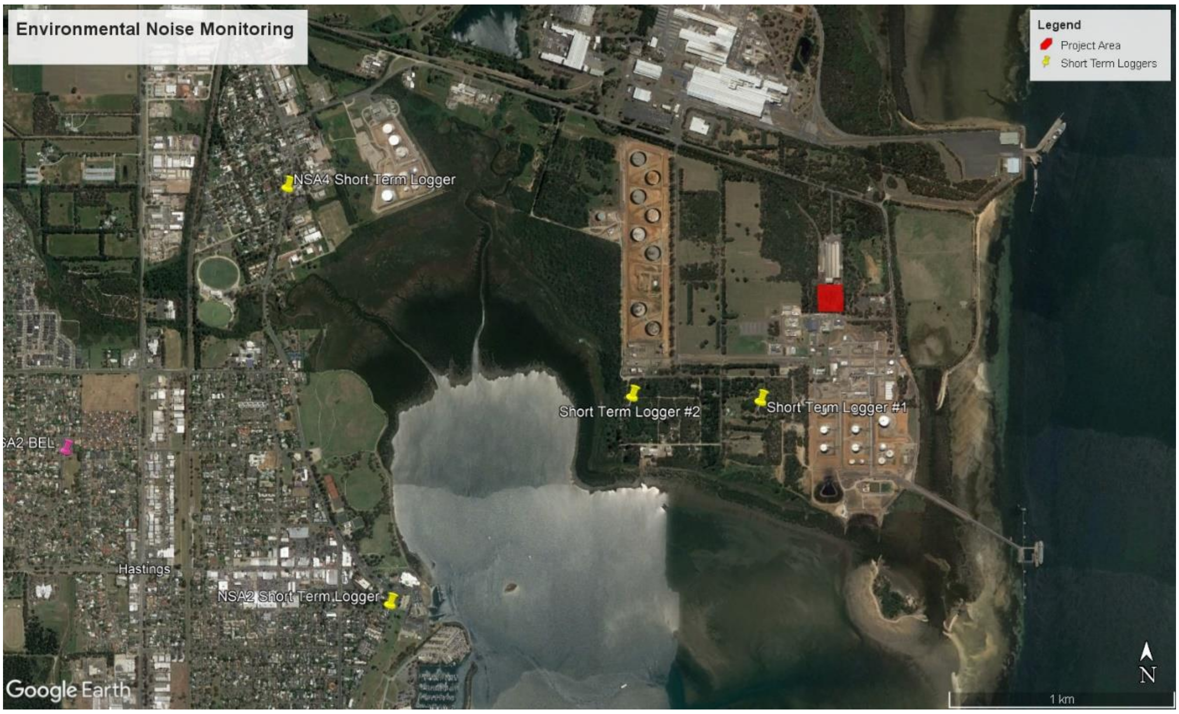


Figure 7-1 Short Term Logger Positions

Logger Name	Serial No.	Latitude	Longitude
Short Term Logger #1	98817	38°18'05.3"S	145°12'52.6"E
Short Term Logger #2	69754	38°18'04.7"S	145°12'29.2"E
NSA2 Short Term Logger	46000	38°18'33.8"S	145°11'47.2"E
NSA4 Short Term Logger	92622	38°17'35.3"S	145°11'26.6"E

Based on site observations at the Short Term Loggers, tones in the 400Hz and 500Hz frequency bands were present at Loggers #1 and #2 and an assessment of tonality was conducted using the objective tonal method in accordance with Annex C[21] of the Noise Protocol. Adjustments if applicable have been made to the measured noise levels to obtain the *effective noise levels (*Table 7-3), which form the basis of the assessment. The short-term logger #1 is representative of NSA1 and NSA5, while the short-term logger #2 is representative of NSA6, NSA7 and NSA8. The effective noise level at NSA4 was adopted for NSA3 due to its vicinity and can be assumed representative of similar noise levels.

Table 7-3 Effective Noise Levels vs Noise Limits

Noise Sensitive Area	Address	Noise limit, dB(A)	Effective noise level, dB(A)
NSA 1	11 Cemetery Rd, Hastings VIC 3915	49	49
NSA 2	65 Skinner St, Hastings VIC 3915	41	40
NSA 3	2 Hodgins Rd, Hastings VIC 3915	41	41
NSA 4	15A Lyall St, Hastings VIC 3915	43	41
NSA 5	34 Cemetery Road, Hastings VIC 3915	49	49
NSA 6	7 Beach Drive, Hastings VIC 3915	46	42
NSA 7	22 Beach Drive, Hastings VIC 3915	48	42
NSA 8	47 Beach Drive, Hastings VIC 3915	45	42
NSA9	14 Skinner St, Hastings VIC 3915	40	40

In addition to the monitoring described above, a long-term noise logger was placed at an alternative location between, but, slightly north of NSA1 and NSA5 for a duration of approximately 1-month. However, based on observations recorded on site, and following analysis of the data collected by this logger, it was considered that the data from short-term logger #1 was more representative of noise received at NSA1 and NSA5. APPENDIX A describes

[21] *Noise Limit and Assessment Protocol for the Control of Noise from Commercial, Industrial and Trade Premises and Entertainment Venues*, EPA Publication 1826.4 Annex C: Objective method for tonal adjustment for commercial, industrial and trade premises.

the long-term logger location and presents an analysis of how this data would affect the calculated effective noise levels.

7.2.1 Cumulative Noise Assessment

Estimation of the cumulative noise from Esso's facilities (LIP and The Project) is presented in Table 7-4 below with levels above the noise limit bolded. The cumulative noise assessment considers the effective noise and the addition of predicted noise generated from The Project.

Table 7-4 Cumulative Effective Noise Level

Noise Sensitive Area	Address	Noise limit, dB(A)	Cumulative Effective Noise level, dB(A)
NSA 1	11 Cemetery Rd, Hastings VIC 3915	49	**51**
NSA 2	65 Skinner St, Hastings VIC 3915	41	41
NSA 3	2 Hodgins Rd, Hastings VIC 3915	41	41
NSA 4	15A Lyall St, Hastings VIC 3915	43	42
NSA 5	34 Cemetery Road, Hastings VIC 3915	49	**51**
NSA 6	7 Beach Drive, Hastings VIC 3915	46	46
NSA 7	22 Beach Drive, Hastings VIC 3915	48	46
NSA 8	47 Beach Drive, Hastings VIC 3915	45	45
NSA9	14 Skinner St, Hastings VIC 3915	40	40

7.3 Low Frequency & Infrasound Noise Assessment

Predictions of low frequency and infrasound noise have been undertaken at all NSAs, with the results compared with the guidelines outlined in Section 5.2.

Sections 7.3.1 and 7.3.2 present results for NSAs 1 and 5 to 8, these NSAs are located closest to The Project and are most likely to be impacted by low frequency and infrasound noise emissions. Predicted low frequency noise emissions from The Project are below the guideline levels at NSAs 2 to 4; the tabulated results are included in APPENDIX F.

Noise contours for low frequency noise contributions for the 1/3 octave bands in the 31.5 Hz to 80 Hz range are located in APPENDIX G.

7.3.1 Low Frequency Noise

The predicted Z-weighted (linear) noise levels have been compared with the low frequency threshold levels (excluding infrasound levels) and are presented in Table 7-5 to Table 7-9, with A-weighted levels also shown in the lower rows for reference. Current baseline noise levels are also presented along with predicted cumulative noise levels.

Table 7-5 Assessment of NSA1 Predicted Low Frequency Levels

1/3 octave Band Frequency Levels (Hz)										
		25	31.5	40	50	63	80	100	125	160
Threshold Levels	LZeq (dB)	69	61	54	50	50	48	48	46	44
	(dBA)	24	22	19	20	24	26	29	30	31
NSA1 – SPL from Exhaust Stack	LZeq (dB)	56	**65**	**59**	**51**	**51**	**49**	47	42	37
	(dBA)	11	25	24	21	25	26	28	25	24
NSA1 Baseline Levels	LZeq (dB)	60	57	**56**	**57**	**55**	**52**	47	41	36
	(dBA)	15	18	22	26	29	29	28	25	23
NSA1 - SPL from Exhaust Stack + Baseline Levels	LZeq (dB)	61	**65**	**61**	**58**	**57**	**54**	**50**	44	40
	(dBA)	17	26	26	27	31	31	31	28	26

Table 7-6 Assessment of NSA5 Predicted Low Frequency Levels

1/3 octave Band Frequency Levels (Hz)										
		25	31.5	40	50	63	80	100	125	160
Threshold Levels	LZeq (dB)	69	61	54	50	50	48	48	46	44
	(dBA)	24	22	19	20	24	26	29	30	31
NSA5 – SPL from Exhaust Stack	LZeq (dB)	56	**64**	**58**	50	50	48	46	40	35
	(dBA)	11	25	24	20	24	25	27	24	22
NSA5 Baseline Levels	LZeq (dB)	60	57	**56**	**57**	**55**	**52**	47	41	36
	(dBA)	15	18	22	26	29	29	28	25	23
NSA5 - SPL from Exhaust Stack + Baseline Levels	LZeq (dB)	61	**65**	**60**	**57**	**56**	**53**	**49**	44	39
	(dBA)	17	26	26	27	30	31	30	27	25

Table 7-7 Assessment of NSA6 Predicted Low Frequency Levels

1/3 octave Band Frequency Levels (Hz)										
		25	31.5	40	50	63	80	100	125	160
Threshold Levels	LZeq (dB)	69	61	54	50	50	48	48	46	44
	(dBA)	24	22	19	20	24	26	29	30	31
NSA6 – SPL from Exhaust Stack	LZeq (dB)	53	**62**	**56**	48	48	46	45	39	35
	(dBA)	8	22	21	18	22	23	26	23	21
NSA6 Baseline Levels	LZeq (dB)	55	56	53	**52**	**52**	**49**	46	42	37
	(dBA)	10	17	18	21	26	27	27	26	23
NSA6 - SPL from Exhaust Stack + Baseline Levels	LZeq (dB)	57	**63**	**57**	**53**	**54**	**51**	48	44	39
	(dBA)	12	23	23	23	28	29	29	28	25

Table 7-8 Assessment of NSA7 Predicted Low Frequency Levels

1/3 octave Band Frequency Levels (Hz)										
		25	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**
Threshold Levels	LZeq (dB)	69	61	54	50	50	48	48	46	44
	(dBA)	24	22	19	20	24	26	29	30	31
NSA7 – SPL from Exhaust Stack	LZeq (dB)	52	61	**55**	47	47	44	43	37	33
	(dBA)	7	21	20	17	21	22	24	21	19
NSA7 Baseline Levels	LZeq (dB)	55	56	53	**52**	**52**	**49**	46	42	37
	(dBA)	10	17	18	21	26	27	27	26	23
NSA7 - SPL from Exhaust Stack + Baseline Levels	LZeq (dB)	57	**62**	**57**	**53**	**53**	**51**	48	43	38
	(dBA)	12	22	22	23	27	28	29	27	25

Table 7-9 Assessment of NSA8 Predicted Low Frequency Levels

1/3 octave Band Frequency Levels (Hz)										
		25	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**
Threshold Levels	LZeq (dB)	69	61	54	50	50	48	48	46	44
	(dBA)	24	22	19	20	24	26	29	30	31
NSA8 – SPL from Exhaust Stack	LZeq (dB)	50	59	53	46	46	44	43	37	33
	(dBA)	6	20	19	15	20	21	24	21	19
NSA8 Baseline Levels	LZeq (dB)	55	56	53	**52**	**52**	**49**	46	42	37
	(dBA)	10	17	18	21	26	27	27	26	23
NSA8 - SPL from Exhaust Stack + Baseline Levels	LZeq (dB)	56	61	**56**	**53**	**53**	**50**	48	43	38
	(dBA)	12	21	21	22	27	28	29	27	25

7.3.2 Infrasound Noise

The predicted Z-weighted (linear) noise levels have been compared with the infrasound frequency threshold levels and are presented in

Table 7-10 to Table 7-14 , with A-weighted levels also shown in the lower rows for reference. Current baseline noise levels are also presented along with predicted cumulative noise levels.

Table 7-10 Assessment of NSA1 Predicted Infrasound Levels

1/3 octave Band Frequency Levels (Hz)							
		6.3	**8**	**10**	**12.5**	**16**	**20**
Threshold Levels	LZeq (dB)	-	-	92	89	86	77
	(dBA)	-	-	22	26	29	27

1/3 octave Band Frequency Levels (Hz)							
NSA1	LZeq (dB)	45	50	51	54	53	51
	(dBA)	-41	-28	-20	-10	-4	0
NSA1 Baseline Levels	LZeq (dB)	54	55	54	65	76	66
	(dBA)	-31	-22	-17	2	19	16
NSA1 - SPL from Exhaust Stack + Baseline Levels	LZeq (dB)	55	56	56	66	76	66
	(dBA)	-31	-21	-15	2	19	16

Table 7-11 Assessment of NSA5 Predicted Infrasound Levels

1/3 octave Band Frequency Levels (Hz)							
		6.3	**8**	**10**	**12.5**	**16**	**20**
Threshold Levels	LZeq (dB)	-	-	92	89	86	77
	(dBA)	-	-	22	26	29	27
NSA5	LZeq (dB)	45	50	51	54	52	50
	(dBA)	-41	-28	-20	-10	-4	0
NSA5 Baseline Levels	LZeq (dB)	54	55	54	65	76	66
	(dBA)	-31	-22	-17	2	19	16
NSA5 - SPL from Exhaust Stack + Baseline Levels	LZeq (dB)	55	56	56	66	76	66
	(dBA)	-31	-21	-15	2	19	16

Table 7-12 Assessment of NSA6 Predicted Infrasound Levels

1/3 octave Band Frequency Levels (Hz)							
		6.3	**8**	**10**	**12.5**	**16**	**20**
Threshold Levels	LZeq (dB)	-	-	92	89	86	77
	(dBA)	-	-	22	26	29	27
NSA6	LZeq (dB)	42	47	48	51	50	47
	(dBA)	-44	-31	-23	-13	-7	-3
NSA6 Baseline Levels	LZeq (dB)	48	49	54	54	62	54
	(dBA)	-37	-28	-16	-9	5	3
NSA6 - SPL from Exhaust Stack + Baseline Levels	LZeq (dB)	49	51	55	56	62	55
	(dBA)	-36	-26	-15	-7	5	4

Table 7-13 Assessment of NSA7 Predicted Infrasound Levels

1/3 octave Band Frequency Levels (Hz)							
		6.3	8	10	12.5	16	20
Threshold Levels	LZeq (dB)	-	-	92	89	86	77
	(dBA)	-	-	22	26	29	27
NSA7	LZeq (dB)	41	46	47	50	49	47
	(dBA)	-44	-32	-23	-14	-8	-4
NSA7 Baseline Levels	LZeq (dB)	48	49	54	54	62	54
	(dBA)	-37	-28	-16	-9	5	3
NSA7 - SPL from Exhaust Stack + Baseline Levels	LZeq (dB)	49	51	55	56	62	55
	(dBA)	-36	-27	-15	-8	5	4

Table 7-14 Assessment of NSA8 Predicted Infrasound Levels

1/3 octave Band Frequency Levels (Hz)							
		6.3	8	10	12.5	16	20
Threshold Levels	LZeq (dB)	-	-	92	89	86	77
	(dBA)	-	-	22	26	29	27
NSA8	LZeq (dB)	39	44	45	48	47	45
	(dBA)	-46	-34	-25	-15	-10	-6
NSA8 Baseline Levels	LZeq (dB)	48	49	54	54	62	54
	(dBA)	-37	-28	-16	-9	5	3
NSA8 - SPL from Exhaust Stack + Baseline Levels	LZeq (dB)	49	51	55	55	62	54
	(dBA)	-37	-27	-15	-8	5	4

8 DISCUSSION

8.1 Predicted Noise Levels

The predicted noise levels from The Project presented in Table 7-1 indicate that noise emissions due to the operation of The Project, when considered in isolation, would fall below the noise limits at all noise sensitive areas. At NSA1, the closest receiver to the proposed facility, predicted noise levels are ~ 3 dB less than the noise limit and 1 dB less than the limit when tonality adjustments are applied. The noise levels at receivers within Hastings town are predicted to be at least ~ 7 dB less than the noise limit.

8.2 Cumulative Noise Assessment

The cumulative assessment results presented in Table 7-4 indicate that noise emissions due to the operation of The Project in conjunction with existing industry would be greater than the noise limits at two of the closest NSAs to the Project, NSA1 and NSA5, by 2 dB(A). The noise emissions at all remaining noise sensitive areas identified in the assessment are at or below the noise limits and are thus compliant with the relevant regulations.

The assessment of effective noise levels indicate that current noise emissions of the LIP facility are equal to the noise limits at locations close to the facility presented Table 7-3. This indicates that the LIP facility contributes more than The Project to the cumulative noise levels that are greater than noise limits.

The predictive noise modelling undertaken for the assessment incorporates the following noise attenuation measures within the Solar Titan 130 equipment packages:

- Acoustic blanket on engine air inlet silencer and flex duct;
- Acoustic blanket on engine exhaust expansion joint;
- Cladding on web of skid beam;
- Additional enclosure door seals; and
- Acoustic blanket on ventilation inlet elbow and fans.
- Low noise lube oil cooler

8.3 General Environmental Duty (GED)

Consistent with the General Environmental Duty (GED) under the Environmental Protection Act 2017, Esso's tendering process included an assessment of control options to minimise the impact and risk to human health and environmental so far as reasonably practicable. This assessment was conducted in accordance with the hierarchy of controlling hazards and risks outlined in EPA

Publication 1695.1[22] and EPA Publication 1856[23]. As a result, Esso selected gas turbine generators that incorporate the Vendor's standard noise control options (i.e. inlet and exhaust silencers, and enclosures) and additional noise controls, including acoustic blankets, cladding, door seals and low noise coolers. Refer to APPENDIX H for a full breakdown of the hazard risk register and refer to Section 9 for practicable controls.

Through the implementation of Esso's Operations Integrity Management System (OIMS), the Hastings Generation Plant will adopt a process of continual improvement, minimising risks to human health and the environment by operating in accordance with the following documentation:

- Risk Management and Monitoring Plan
- Environmental Management Plan
- Environmental Monitoring Plan, including an Operational Noise Management Plan
- Environmental Commissioning Plan

8.4 Low Frequency & Infrasound Noise

8.4.1 Low Frequency Noise

The assessment results for the noise sensitive areas presented in Section 7.3, and summarised in Table 7-5 to Table 7-9, indicates the following:

- NSA 1:
    - Predicted noise emissions exceed the guidelines in the 31.5 Hz to 80 Hz bands.
        - However, the exceedances in the 50 Hz to 80 Hz bands fall below the baseline levels measured by Wood and therefore are unlikely to be audible.
        - Received levels in the 31.5 Hz and 40 Hz may potentially be faintly audible.
- NSAs 2 to 4:
    - Predicted low frequency noise emissions from The Project are below the guideline levels.

[22] EPA Publication 1659.1 – Assessing and controlling risk: A guide for business

[23] EPA Publication 1856 – Reasonably practicable

- NSA 5:
    - Predicted low frequency noise emissions exceed the guidelines in the 31.5 Hz to 63 Hz bands.
        - However, the exceedances in the 50 Hz and 63 Hz bands are below the baseline levels measured by Wood and therefore unlikely to be audible.
        - Received levels in the 31.5 Hz and 40 Hz may potentially be faintly audible.
- NSA 6:
    - Predicted noise emissions exceed the guidelines in the 31.5 Hz and 40 Hz bands.
        - Predicted noise in the 40 Hz band is less than 2 dB above the guidance level, and less than 3 dB above current baselines levels, and may potentially be faintly audible.
        - Predicted noise in the 31.5 Hz band is less than 1 dB above the guidance level and may potentially be faintly audible.
- NSA 7:
    - Predicted noise in the 40 Hz band is less than 1dB above the guidance level, and less than 2 dB above current baselines levels, and may potentially be faintly audible.
- NSA 8:
    - Predicted low frequency noise emissions from The Project are below the guideline levels.

A number of the exceedances fall below the background noise levels and are unlikely to be discernible. The predicted noise levels from The Project at NSA 1 and NSA 5 in the 50 Hz band is approximately 20 dB(A), which is equivalent to the overall noise from *Inside a Bedroom – Window Closed* according to the Table of Equivalent Noise Source provided by NSW EPA in APPENDIX I. Predicted noise levels in the 31.5 Hz, 40 Hz, 63 Hz and 80 Hz are approximately 25 dB(A), which equivalent to the overall noise between *Inside a Bedroom – Window Closed* and *a quiet countryside.*

8.4.2 Infrasound Noise

Predicted infrasound noise levels from The Project are significantly below the threshold levels at all noise sensitive areas and there are no exceedances under the 20 Hz range for cumulative infrasound levels, therefore it is not anticipated that there will be any significant infrasound to emanate from The Project.

8.5 Noise Management Plan

Prior to commissioning The Project will develop an Environmental Commissioning Plan and an Operational Noise Management Plan.

The Environmental Commissioning Plan will be prepared and submitted to the EPA approval prior to the commencement of commissioning activities. This plan will include a process for verification and assessment of plant noise emissions following the start of operations to confirm the modelling assumptions applied in this report.

The Operational Noise Management Plan will include details of major noise sources associated with The Project and details of noise management measures for major noise sources, including:

- Inspection and maintenance programs for noise controls (where applicable) to ensure noise controls are functioning as designed;
- Implementation of continual improvement with regards to noise control and operational noise emissions, to ensure the risk of harm from noise to human health and the environment is minimised so far as reasonably practicable, through across the whole life of the project; and
- Details of contingency measures to be implemented to address, as necessary, the risk of exceedance of the Project Noise Criteria or of the noise limits of the Regulations.

The project has implemented a Complaints Investigation and Response Plan, that details the measures to be taken to address complaints, including noise related complaints.

9 NOISE CONTROL RECOMMENDATIONS

9.1 Proposed Noise Controls

The following noise controls are proposed to be installed on the package as part of Solar's scope of supply, they consist of Standard noise controls offered on all Titan 130 package and Additional noise controls purchased / implemented by Esso.

Standard Noise Controls:

The following noise controls are offered as standard by Solar:

- Turbine air inlet silencer
- Turbine exhaust silencer
- Ventilation exhaust silencer
- Standard low noise enclosure

Additional Noise Control Options Implemented by Esso:

The additional controls implemented by Esso are listed below and illustrated in Figure 9-1.

- Acoustic blanket on turbine air inlet silencer and flex duct (~2 dB reduction);
    - This blanket provides attenuation for the turbine air inlet silencer and flexible duct connection to the enclosure. The flange ducting connection to the enclosure and the ducting from the enclosure upstream to the silencer are typically higher noise components of the package. This is due to noise breaking out from within the ducts. The blanket provides noise attenuation for these equipment items.
- Acoustic blanket on engine exhaust expansion joint (~2 dB reduction);
    - Expansion joints are typically an acoustic weak point where noise leakage is likely to occur. Installation of an acoustic blanket over the expansion joint will reduce noise emissions.
- Addition of cladding on web of skid beam (skid skirt) (~2 dB reduction);
    - Noise from the turbine baseplate can radiate from under the skid beam and can be a significant noise source. The installation of a skirt reduces noise radiating from under the skid.
- Additional enclosure door seals (~2 dB reduction);

- Enclosure doors are typically an acoustic weak point for the enclosure where noise leakage is likely to occur. The installation of door seals will reduce noise break-out from the enclosure.

- Acoustic blanket on ventilation inlet elbow and fans (~2 dB reduction); and
  - This blanket provides noise attenuation for the ventilation air inlet including breakout noise from the ventilation fan casing. These can be high noise equipment items – particularly for the fan casing and connections to the ducting. The installation of a blanket over the inlet ducting and fan casing will reduce noise emissions from these equipment items.
- Low noise Lube Oil Coolers (~4 dB reduction);
  - The external lube oil coolers selected by Esso include a low noise variable speed fan. Variable speed fans are typically lower noise than the fixed speed fans. The sound power levels provided by Solar for the low noise lube oil coolers are quieter than industry standard and in-line with low noise options provided by gas turbines manufacturers.

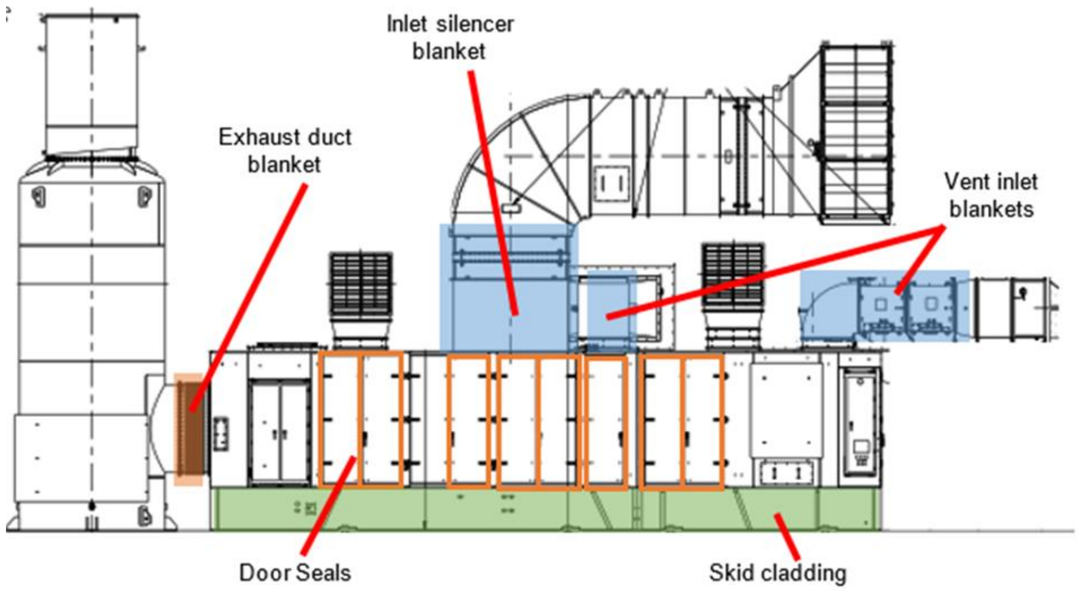


Figure 9-1 Illustration of Additional Noise Controls Procured by Esso (Source: Solar)

Solar has indicated that implementation of the above noise controls is anticipated to reduce overall package sound power to the levels listed in Table 9-1.

Table 9-1 Summary of Additional Noise Control Reductions

Equipment Item	Standard Noise Attenuation	Additional Noise Controls
	Sound Power Level, dB(A)	Sound Power Level, dB(A)
Gas turbine generator package	111	107
Lube oil cooler	100	96

9.2 Noise Controls Considered Not Practicable

The following noise controls were considered, however not recommended for implementation, as they were found to be not practicable or provided minimal reduction in noise emissions from the facility.

- Fuel Gas Skids
  - Noise emanating from the fuel gas skid is the result of flow noise generated from within the valves. Valve noise is typically high frequency noise. High frequency noise attenuates readily across long distances. Additionally, noise levels received at NSAs is dominated by the Titan 130 packages. Potential noise control treatments include the installation of low noise trim valves or acoustic insulation over piping downstream of the valve. However, due to the high frequency and low intensity nature of valve noise, installation of these noise controls would likely have an insignificant effect on received noise levels at nearby NSAs.
- Instrument Air Package
  - The instrument air package is an enclosed package which the enclosure readily designed with noise attenuation in mind. Enclosures for modern packages are typically medium to high performance. Implementing a higher specification enclosure to lower emissions even lower would likely have an insignificant effect on the noise levels at received at the nearby NSAs due to the low intensity nature of noise from the package.
- Transformer
  - Noise from transformer is usually resulting from cooling fans. Installation of low noise fans can reduce noise emissions from the package. However, any installation of noise controls would likely have an insignificant effect of noise levels at NSAs due to the package having a low sound power level.
- Noise Walls

- Implementation of noise walls to the southern side of the compressor packages for the purposes of reducing noise impacts at the closest NSAs was considered not practicable due to the following:
    - Any noise wall would need to block line of sight between the packages and the nearest NSAs. To achieve this a noise walls would need to be approximately 70m long and at least 10m tall. A noise wall of this height and length could create significant load bearing issues under strong winds and would therefore require complex structural engineering; and
    - The dominant noise source at NSAs is the combustion exhaust outlet (~15 m above ground) which would not be attenuated by a noise wall due to the height of the stack.

9.3 Noise Controls for Low Frequency Noise

Noise modelling predicts that the low frequency noise (inclusive of infrasound) is likely originating from the Titan 130 package, in particularly the exhaust stack outlet and, to a lesser extent, the enclosure and associated ducting and inlets / outlets.

Solar has installed a silencer in the combustion exhaust stack. Silencers typically provide attenuation in the high frequency bands and often have minimal impact on low frequency / infrasound noise. A custom-built high-performance exhaust silencer would likely provide only a marginal improvement with regards to low frequency / infrasound emissions from the exhaust. Additionally, this would have to be sourced from an alternate vendor and installed post construction of the package.

Solar has provided a number of noise controls for the enclosure, associated ducting and inlets / outlets, listed in section 9.1 that Esso has accepted. These controls primarily provide noise reduction in the higher frequency bands, and while they may provide some reduction in the infrasound and low frequency range, it will be minimal.

Further reduction of low frequency noise and infrasound from the Titan 130 turbine packages is very difficult due to the very long wavelengths of the emissions (e.g. wavelength of 10 Hz noise is 34.4 metres long). Changes to the operating conditions of the package were reviewed to determine if reductions in low frequency noise emissions could be achieved. It was determined that only minimal reductions would be possible in the low frequency noise and infrasound emissions, and it may lead to stability and reliability issues with the package. Therefore changing operational conditions is not considered practicable

10 CONCLUSION

10.1 Project Noise

Modelling of noise emissions from The Project has shown no exceedances of the night-time noise limits.

10.1.1 Cumulative Project Noise Levels

Noise impacts at nine of the closest noise sensitive areas has been assessed based on noise modelling and background noise monitoring of The Project.

The modelling and consideration of cumulative noise levels undertaken indicate that at NSA1 and NSA5, noise limits are exceeded by 2 dB. At all remaining NSAs cumulative noise levels are at or below the noise limits and therefore compliance is met, under adverse meteorological conditions.

The exceedances of noise limits are due to the existing measured noise levels at the LIP facility and tonality adjustments to the predicted noise levels. Tonality adjustments have been made to both the predicted noise levels and the measured noise levels; a conservative approach which could potentially overestimate actual impacts.

An assessment of cumulative noise levels over a long-term noise logging period was conducted and results presented in APPENDIX A

It is recommended that once operating, the noise control measures for the Solar Titan 130 packages outlined in Section 9.1, are clearly specified in the project procurement and design details, and their inclusion verified for the as-built plant. It is also recommended that noise levels are measured at the NSAs once commissioned.

10.1.2 Low Frequency and Infrasound Noise

Low frequency noise impacts at nine of the closest noise sensitive areas have been modelled and assessed against the low frequency noise guidelines. The assessment predicts low frequency noise may result in exceedances of the threshold guidelines at NSA 1 and NSAs 5 through 8. The exceedances occur in the 31.5 Hz to 80 Hz 1/3 octave bands, although not all the NSAs exceed throughout the entire range. Existing measured levels are exceeding the thresholds in the 50 Hz to 80 Hz bands for NSA6 – NSA8, and in the 40 Hz to 80 Hz bands for NSA1 and NSA5.

Predicted exceedances are very close to or fall below the base measured noise levels and therefore unlikely to be audible. Received levels in the 31.5 Hz and 40 Hz may potentially be faintly audible at NSA 1 and NSA 5, while predicted levels at NSA 6 and NSA 7 are within 1 dB of the guidance level in the 31.5 Hz and 40 Hz bands, respectively, and may potentially be faintly audible.

Predicted infrasound noise levels from The Project are significantly below the threshold levels at all noise sensitive areas and there are no exceedances under the 20 Hz range for cumulative infrasound levels, therefore it is not anticipated that there will be any significant infrasound to emanate from The Project.

10.2 Noise Control Assessment

The following noise controls are proposed to be installed on the package as part of Solar's scope of supply, they consist of Standard noise controls offered on all Titan 130 package and Additional noise controls purchased/ implemented by Esso.

Standard Noise Controls:

- Turbine air inlet silencer
- Turbine exhaust silencer
- Ventilation exhaust silencer
- Standard low noise enclosure

Additional Noise Control Options Implemented by Esso:

- Acoustic blanket on engine air inlet silencer and flex duct;
- Acoustic blanket on engine exhaust expansion joint;
- Cladding on web of skid beam;
- Additional enclosure door seals; and
- Acoustic blanket on ventilation inlet elbow and fans

Table 10-1 lists the current and additional noise control options and provides the anticipated reductions to overall sound power levels as indicated by Solar.

Table 10-1 Summary of Standard and Additional Noise Controls

Equipment Item	Standard Noise Attenuation		Additional Noise Control	
	Noise Control Description	Sound Power Level, dB(A)	Noise Control Description	Sound Power Level, dB(A)
Gas turbine generator package	Ventilation exhaust silencer Standard low noise enclosure	111	Acoustic blanket on engine air inlet silencer and flex duct Acoustic blanket on engine exhaust expansion joint	107

Equipment Item	Standard Noise Attenuation		Additional Noise Control	
	Noise Control Description	Sound Power Level, dB(A)	Noise Control Description	Sound Power Level, dB(A)
			Cladding on web of skid beam Additional enclosure door seals Acoustic blanket on ventilation inlet elbow and fans	
Exhaust stack outlet	Ventilation exhaust silencer	103		103
Lube oil cooler		100	Low noise fan	96
Turbine air inlet	Silencer on the air inlet	97		97
Fuel gas skid		96		96
Instrument air package	Enclosure of the instrument air package	95		95
Transformer		90		90

Following implementation of the additional noise controls, noise emissions from The Project is considered to have been reduced to a reasonable level and risk of exceedance at the NSAs is low.

10.3 Noise Management Plan

Prior to commissioning The Project will develop an Operational Noise Management Plan to manage noise emissions through the operations phase.

Section 8.5 of the report provides further details of recommended inclusions in the Operational Noise Management Plan.

10.4 Construction Noise

The project has advised that major construction activities involving mobile equipment and loud hand tools will be limited to the normal working hours detailed in Table 3-1. For construction activities undertaken during normal working hours it is recommended that The Project follow the guidance outlined in Section 4.3 of EPA's Publication 1834 to minimise noise and vibration risk as far as reasonably practicable. Guidance in Section 4.3 of the EPA's Publication 1834 covers:

- Scheduling of works

- Community information and consultation
- Controlling noise at the source
- Limiting vibration and regenerated noise (jackhammers, rock breakers etc..)
- Noise reduction between noise source and receiver

Night construction works are not anticipated involve the use of significant mobile or fixed plant noise sources, and the additional power and lighting will be powered by existing power sources, eliminating the need for portable generators. Therefore, it is anticipated that The Project will meet the EPA's guidelines for noise levels for construction works undertaken outside the normal working hours.

APPENDIX A LONG TERM LOGGER ANALYSIS

A noise logger was placed in the vicinity of NSA1 and NSA5 for a duration of approximately 1-month. An analysis of this logger was conducted to determine the effective noise levels over a longer monitoring period. The sections below outline the results.

A.1.1 Long Term Logger Location and Duration

Figure 10-1 shows the location of the long-term logger in reference to the NSAs and short-term loggers, and Table 10-2 shows the position (in degrees, minutes, seconds).

Figure 10-1 Long Term Logger Location

Table 10-2 Long Term Logger Coordinates

Logger Name	Latitude	Longitude	Duration
Long Term Logger	38°17'58.1"S	145°12'48.8"E	28th August – 21st September

A.1.2 Effective Noise Levels

Based on site observations an assessment of tonality was conducted using the objective tonal method in accordance with Annex C of the Noise Protocol. An adjustment has been made to the measured noise level to obtain the long-term effective noise level. The effective noise level at the long-term logger has been adopted for both NSA1 and NSA5 and the total cumulative results are presented in Table 10-3.

Table 10-3 Cumulative Effective Noise Level using Long Term Logger

Noise Sensitive Area	Address	Noise limit, dB(A)	Adjusted Predicted Noise Level, dB(A)	Long Term Logger Effective Noise level, dB(A)	Cumulative Effective Noise level, dB(A)
NSA 1	11 Cemetery Rd, Hastings VIC 3915	49	47.9	47	**50**
NSA 5	34 Cemetery Road, Hastings VIC 3915	49	47.0	47	**50**

A.1.3 Discussion

The effective noise level measured by the long-term logger was less than the short-term logger #1 by 2 dB. This is due to a number of factors such as line of site from equipment from the southern part of LIP to the NSA, weather conditions and topography.

During the monitoring period when both loggers were deployed, the short-term logger consistently recorded noise levels that were higher than the long-term logger, in line with site observations. It was observed that the noise at the short-term logger #1 was notably distinct from the location of the long-term logger, with specific sources from the LIP facility being identifiable at the short-term logger.

Using the effective noise level from the long-term noise logger in addition to the predicted noise levels from Section 7.1, the cumulative levels have been assessed. The cumulative effective noise level is above the noise limit by 1 dB rather than 2 dB when using the short-term noise logger. As a result, the short-term logger results have been used in assessing cumulative levels in Section 7 to represent a worst-case scenario.

APPENDIX B ATTENDED BACKGOUND NOISE MONITORING DATA

NSA	Start Time / Date	Elapsed Time	LAeq	LAF_{10}	LAF_{90}	Weather Observations	Noise Observations
NSA 1 BEL	5/06/2023 23:38:55	00:10:00	38.1	39.4	35.5	Calm, clear skies	Occasional traffic and insect noise.
	6/06/2023 0:11:30	00:10:00	40.0	40.1	36.3		
NSA 2 BEL	6/06/2023 1:22:52	00:10:00	40.6	41.8	39.4	Calm, clear skies	Occasional traffic, bird, and bat noise.
	6/06/2023 1:32:52	00:10:00	40.6	42.2	38.5		
	6/06/2023 3:58:26	00:10:00	39.8	41.6	35.6		
	6/06/2023 4:10:05	00:10:00	38.5	40.1	36.1		

APPENDIX C SOUND SOURCE POWER LEVELS

	Octave Band Sound Power Level, in dB																																	
Source Name	**6**	**8**	**10**	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**	**200**	**250**	**315**	**400**	**500**	**630**	**800**	**1k**	**1.25k**	**1.6k**	**2k**	**2.5k**	**3.15k**	**4k**	**5k**	**6.3k**	**8k**	**10k**	**SWL (dBA)**
Titan 130 GTG Package	-	-	-	92	87	93	114	98	97	104	100	97	100	108	113	99	95	99	97	94	98	100	95	94	97	95	89	94	89	79	75	74	70	**107**
Combustion Exhaust Stack Outlet	104	109	110	113	112	110	116	124	118	112	112	110	110	105	100	98	98	92	91	91	89	91	92	89	88	87	86	85	93	89	85	81	78	**102.4**
Turbine Air Inlet	-	-	-	92	87	93	93	90	91	88	89	93	88	87	91	89	89	86	84	83	80	80	79	81	94	86	78	81	77	73	68	62	56	**97**
Lube Oil Cooler	-	-	-	-	-	-	98	98	92	94	97	99	96	93	87	86	88	89	87	87	87	85	84	83	81	81	79	82	88	84	79	80	78	**95.9**
Instrument Air Package	-	-	-	80	80	80	86	88	91	84	85	84	82	82	88	81	97	81	83	78	77	87	75	79	83	82	80	87	75	71	70	67	62	**94.6**
Fuel Gas Skid Valve	-	-	-	96	118	115	113	110	108	105	101	98	96	93	90	88	86	85	82	82	83	81	81	86	83	85	84	85	83	86	85	82	82	**96.1**
Transformer	-	-	-	81	78	78	75	75	76	77	77	79	99	81	80	98	80	83	84	80	76	76	75	74	74	72	71	69	68	67	68	61	57	**90.2**

APPENDIX D PREDICTED PROJECT NOISE IMPACT

APPENDIX E MEASURED AMBIENT NOISE

NSA	Duration	Night-time average LAeq	Night-time LAeq adjusted for tonality
Short Term Logger #1	14th – 19th September	47	49
Short Term Logger #2	14th – 21st September	42	-
NSA2 Short Term Logger	14th – 18th September	40	-
NSA4 Short Term Logger	14th – 18th September	41	-
Long Term Logger	28th August – 21st September	45	47

APPENDIX F LOW FREQUENCY NOISE ASSESSMENT RESULTS

F.1.1 NSA1 Assessment of Infrasound and Low Frequency Noise Impacts

One-third Octave Frequency Levels (Hz dB)																
		6.3	**8**	**10**	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**
Threshold Levels	Leq (dB)	-	-	92	89	86	77	69	61	54	50	50	48	48	46	44
	(dBA)	-	-	22	26	29	27	24	22	19	20	24	26	29	30	31
NSA1	Leq (dB)	45	50	51	54	53	51	56	**65**	**59**	**51**	**51**	**49**	47	42	37
	(dBA)	-41	-28	-20	-10	-4	0	11	25	24	21	25	26	28	25	24
NSA1 Baseline Levels	Leq (dB)	54	55	54	65	76	66	60	57	**56**	**57**	**55**	**52**	47	41	36
	(dBA)	-31	-22	-17	2	19	16	15	18	22	26	29	29	28	25	23
NSA1 - SPL from Exhaust Stack + Baseline Levels	Leq (dB)	55	56	56	66	76	66	61	**65**	**61**	**58**	**57**	**54**	**50**	44	40
	(dBA)	-31	-21	-15	2	19	16	17	26	26	27	31	31	31	28	26

F.1.2 NSA2 Assessment of Infrasound and Low Frequency Noise Impacts

One-third Octave Frequency Levels (Hz dB)																
		6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Threshold Levels	Leq (dB)	-	-	92	89	86	77	69	61	54	50	50	48	48	46	44 .0
	(dBA)	-	-	22	26	29	27	24	22	19	20	24	26	29	30	31
NSA2	Leq (dB)	31	36	37	40	39	37	42	51	46	39	39	37	37	31	26
	(dBA)	-54	-42	-33	-24	-18	-14	-3	11	11	8	13	14	18	15	13
NSA2 Baseline Levels	Leq (dB)	56	56	56	57	60	55	51	49	48	48	46	45	44	41	38
	(dBA)	-30	-22	-15	-7	4	4	7	9	13	18	19	23	25	25	25
NSA2 - SPL from Exhaust Stack + Baseline Levels	Leq (dB)	56	56	56	57	60	55	52	53	50	48	46	46	45	42	38
	(dBA)	-30	-22	-15	-7	4	4	7	13	15	18	20	23	26	26	25

F.1.3 NSA3 Assessment of Infrasound and Low Frequency Noise Impacts

One-third Octave Frequency Levels (Hz dB)																
		6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Threshold Levels	Leq (dB)	-	-	92	89	86	77	69	61	54	50	50	48	48	46	44
	(dBA)	-	-	22	26	29	27	24	22	19	20	24	26	29	30	31
NSA3	Leq (dB)	32	37	38	41	40	38	43	52	46	39	39	37	37	32	27
	(dBA)	-53	-41	-32	-22	-17	-12	-1	13	12	9	13	14	18	15	14
NSA3 Baseline Levels	Leq (dB)	54	53	52	49	50	45	44	43	43	43	42	41	40	38	37
	(dBA)	-31	-25	-18	-15	-7	-6	0	4	9	13	16	19	21	22	23
NSA3 - SPL from Exhaust Stack + Baseline Levels	Leq (dB)	54	53	52	49	51	46	47	53	48	44	44	43	42	39	37
	(dBA)	-31	-25	-18	-14	-6	-5	2	13	13	14	18	20	23	23	24

F.1.4 NSA4 Assessment of Infrasound and Low Frequency Noise Impacts

One-third Octave Frequency Levels (Hz dB)																
		6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Threshold Levels	Leq (dB)	-	-	92	89	86	77	69	61	54	50	50	48	48	46	44
	(dBA)	-	-	22	26	29	27	24	22	19	20	24	26	29	30	31
NSA4	Leq (dB)	31	36	37	40	39	37	42	51	45	37	37	35	35	29	24
	(dBA)	-55	-42	-34	-24	-18	-14	-3	11	10	7	11	13	16	13	11
NSA4 Baseline Levels	Leq (dB)	54	53	52	49	50	45	44	43	43	43	42	41	40	38	37
	(dBA)	-31	-25	-18	-15	-7	-6	0	4	9	13	16	19	21	22	23
NSA4 - SPL from Exhaust Stack + Baseline Levels	Leq (dB)	54	53	52	49	50	45	46	51	47	44	44	42	41	39	37
	(dBA)	-31	-25	-18	-14	-6	-5	2	12	13	14	17	20	22	23	24

F.1.5 NSA5 Assessment of Infrasound and Low Frequency Noise Impacts

One-third Octave Frequency Levels (Hz dB)																
		6.3	**8**	**10**	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**
Threshold Levels	Leq (dB)	-	-	92	89	86	77	69	61	54	50	50	48	48	46	44
	(dBA)	-	-	22	26	29	27	24	22	19	20	24	26	29	30	31
NSA5	Leq (dB)	45	50	51	54	52	50	56	**64**	**58**	50	50	48	46	40	35
	(dBA)	-41	-28	-20	-10	-4	0	11	25	24	20	24	25	27	24	22
NSA5 Baseline Levels	Leq (dB)	54	55	54	65	76	66	60	57	**56**	**57**	**55**	**52**	47	41	36
	(dBA)	-31	-22	-17	2	19	16	15	18	22	26	29	29	28	25	23
NSA5 - SPL from Exhaust Stack + Baseline Levels	Leq (dB)	55	56	56	66	76	66	61	**65**	**60**	**57**	**56**	**53**	**49**	44	39
	(dBA)	-31	-21	-15	2	19	16	17	26	26	27	30	31	30	27	25

F.1.6 NSA6 Assessment of Infrasound and Low Frequency Noise Impacts

One-third Octave Frequency Levels (Hz dB)																
		6.3	**8**	**10**	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**
Threshold Levels	Leq (dB)	-	-	92	89	86	77	69	61	54	50	50	48	48	46	44
	(dBA)	-	-	22	26	29	27	24	22	19	20	24	26	29	30	31
NSA6	Leq (dB)	42	47	48	51	50	47	53	**62**	**56**	48	48	46	45	39	35
	(dBA)	-44	-31	-23	-13	-7	-3	8	22	21	18	22	23	26	23	21
NSA6 Baseline Levels	Leq (dB)	48	49	54	54	62	54	55	56	53	**52**	**52**	**49**	46	42	37
	(dBA)	-37	-28	-16	-9	5	3	10	17	18	21	26	27	27	26	23
NSA6 - SPL from Exhaust Stack + Baseline Levels	Leq (dB)	49	51	55	56	62	55	57	**63**	**57**	**53**	**54**	**51**	48	44	39
	(dBA)	-36	-26	-15	-7	5	4	12	23	23	23	28	29	29	28	25

F.1.7 NSA7 Assessment of Infrasound and Low Frequency Noise Impacts

One-third Octave Frequency Levels (Hz dB)																
		6.3	**8**	**10**	**12.5**	**16**	**20**	**25**	**31.5**	**40**	**50**	**63**	**80**	**100**	**125**	**160**
Threshold Levels	Leq (dB)	-	-	92	89	86	77	69	61	54	50	50	48	48	46	44
	(dBA)	-	-	22	26	29	27	24	22	19	20	24	26	29	30	31
NSA7	Leq (dB)	41	46	47	50	49	47	52	61	**55**	47	47	44	43	37	33
	(dBA)	-44	-32	-23	-14	-8	-4	7	21	20	17	21	22	24	21	19
NSA7 Baseline Levels	Leq (dB)	48	49	54	54	62	54	55	56	53	**52**	**52**	**49**	46	42	37
	(dBA)	-37	-28	-16	-9	5	3	10	17	18	21	26	27	27	26	23
NSA7 - SPL from Exhaust Stack + Baseline Levels	Leq (dB)	49	51	55	56	62	55	57	**62**	**57**	**53**	**53**	**51**	48	43	38
	(dBA)	-36	-27	-15	-8	5	4	12	22	22	23	27	28	29	27	25

F.1.8 NSA8 Assessment of Infrasound and Low Frequency Noise Impacts

One-third Octave Frequency Levels (Hz dB)																
		6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Threshold Levels	Leq (dB)	-	-	92	89	86	77	69	61	54	50	50	48	48	46	44
	(dBA)	-	-	22	26	29	27	24	22	19	20	24	26	29	30	31
NSA8	Leq (dB)	39	44	45	48	47	45	50	59	53	46	46	44	43	37	33
	(dBA)	-46	-34	-25	-15	-10	-6	6	20	19	15	20	21	24	21	19
NSA8 Baseline Levels	Leq (dB)	48	49	54	54	62	54	55	56	53	**52**	**52**	**49**	46	42	37
	(dBA)	-37	-28	-16	-9	5	3	10	17	18	21	26	27	27	26	23
NSA8 - SPL from Exhaust Stack + Baseline Levels	Leq (dB)	49	51	55	55	62	54	56	61	**56**	**53**	**53**	**50**	48	43	38
	(dBA)	-37	-27	-15	-8	5	4	12	21	21	22	27	28	29	27	25

F.1.9 NSA9 Assessment of Infrasound and Low Frequency Noise Impacts

One-third Octave Frequency Levels (Hz dB)																
		6.3	8	10	12.5	16	20	25	31.5	40	50	63	80	100	125	160
Threshold Levels	Leq (dB)	-	-	92	89	86	77	69	61	54	50	50	48	48	46	44 .0
	(dBA)	-	-	22	26	29	27	24	22	19	20	24	26	29	30	31
NSA9	Leq (dB)	31	36	37	40	46	43	45	51	45	39	38	36	36	35	39
	(dBA)	-55	-42	-34	-24	-11	-7	1	11	11	9	12	14	17	19	25
NSA9 Baseline Levels	Leq (dB)	56	56	56	57	60	55	51	49	48	48	46	45	44	41	38
	(dBA)	-30	-22	-15	-7	4	4	7	9	13	18	19	23	25	25	25
NSA9 - SPL from Exhaust Stack + Baseline Levels	Leq (dB)	56	56	56	57	60	55	52	53	50	48	46	46	45	42	41
	(dBA)	-30	-22	-15	-7	4	5	8	13	15	18	20	23	26	26	28

APPENDIX G LOW FREQUENCY NOISE CONTOURS

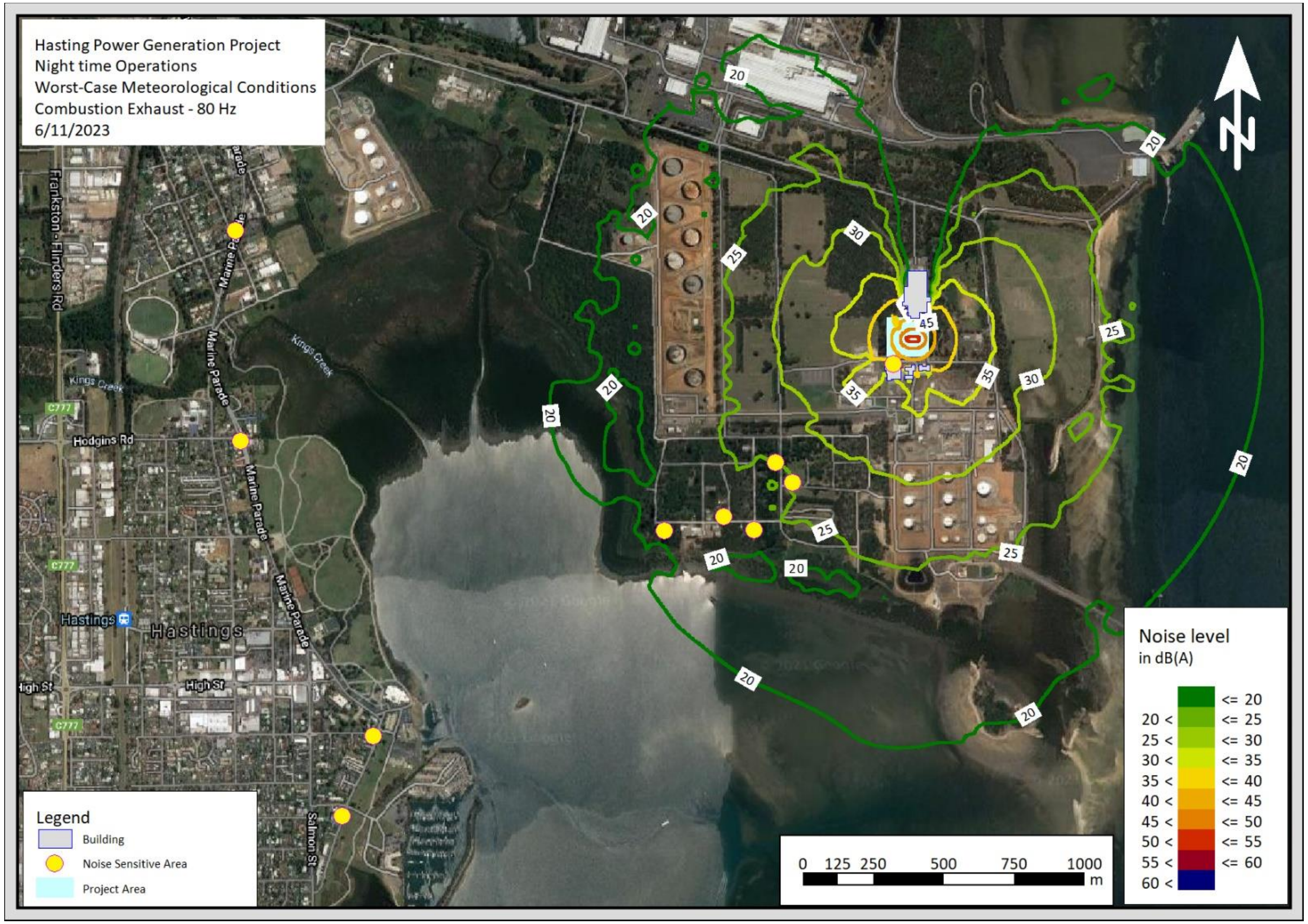
G.1.1 Low Frequency Contour 31.5 Hz

G.1.2 Low Frequency Contour 40 Hz

G.1.3 Low Frequency Contour 50 Hz

G.1.4 Low Frequency Contour 63 Hz

G.1.5 Low Frequency Contour 80 Hz



APPENDIX H HAZARD RISK REGISTER

Hazard	Risk Assessment			Degree of Harm	Controls / Steps Taken	Control Practicability
	Likelihood	Consequence	Risk Rating			
Noise emitted from proposed Titan 130 packages and associated equipment results in disturbance at noise sensitive areas (NSA).	Likely – Expected to happen at some time	Moderate – medium level of harm to health and wellbeing or the environment over an extended period.	High – unacceptable level of risk. Controls must be put in place to reduce to lower levels.	Low – Emitted noise levels are below existing ambient noise levels	Equipment selection: Esso assessed different suppliers during the planning phase, and the selection criteria included noise impacts along with impacts from water usage and emissions to air. During the tendering process vendors were requested to provide noise control measures, and these were evaluated against low noise criteria.	Practicable – Vendor was selected based on being able to meet the low noise criteria for the turbine packages.
					Titan 130 Package: The vendor offered the following standard noise controls: • Turbine air inlet silencer • Turbine exhaust silencer • Ventilation exhaust silencer • Standard low noise enclosure	Practicable – These were purchased and implemented by Esso.
					Titan 130 Package: Acoustic blanket on turbine air inlet silencer and flex duct.	Practicable – This provides an approximate 2 dB noise reduction and can be easily implemented.
					Titan 130 Package: Acoustic blanket on engine exhaust expansion joint.	Practicable – This provides an approximate 2 dB noise reduction and can be easily implemented.
					Titan 130 Package: Addition of cladding on web of skid beam (skid skirt).	Practicable – This provides an approximate 2 dB noise reduction and can be easily implemented.
					Titan 130 Package: Additional enclosure door seals.	Practicable – This provides an approximate 2 dB noise reduction and can be easily implemented.
					Titan 130 Package: Acoustic blanket on ventilation inlet elbow and fans.	Practicable – This provides an approximate 2 dB noise reduction and can be easily implemented.
					Titan 130 Package: Low noise lube oil coolers.	Practicable – This provides an approximate 4 dB noise reduction and can be easily implemented.
					Fuel Gas Skids: Installation of low noise trims or acoustic insulation over piping downstream of valves.	Not practicable – Insignificant effect on received noise levels at the NSAs.
					Instrument Air Package: Installation of a higher specification enclosure.	Not practicable – Insignificant effect on received noise levels at the NSAs.

Hazard	Risk Assessment			Degree of Harm	Controls / Steps Taken	Control Practicability
	Likelihood	Consequence	Risk Rating			
					Transformer: Installation of low noise fans.	Not practicable – Insignificant effect on received noise levels at the NSAs
					Titan 130 Package: Noise walls.	Not practicable – Noise walls would need to be 10m in height and create significant load bearing issues. Noise from the exhaust stack (~15m) would not be attenuated by the wall.
					Low Frequency Noise: Higher performance exhaust silencer.	Not practicable – Minimal effect on low frequency noise and infrasound at the NSAs.
					Low Frequency Noise: Changes to operating conditions.	Not practicable – Minimal reductions achieved but will lead to stability and reliability issues of the package.
					Noise Sensitive Receiver Control: Upgrade facades with double glazing etc.	Not practicable – Significant cost implication due to the quantity of structures.

Note: This hazard register is not inclusive of all risks identified for the Project. For a full list of actions and controls refer to Esso's environmental management documentation.

APPENDIX I TABLE OF EQUIVALENT NOISE LEVELS